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## ELECTRIC VEHICLE ASSOCIATION OF AMERICA.

The first convention of the Electric Vehicle Association of America, held in New York last week, clearly disclosed, through its papers and discussions, the need of such an organization, and a most gratifying enthusiasm was displayed by the manufacturing and central-station interests alike in the co-operative movement to place the electric vehicle before the world in its proper light. The program reflected the art as it exists and, considering the newness of the organization and lack of precedents, was excellently prepared. That it by no means sounded all the depths and shoals of the industry was apparent from the very able address of President Blood; for in the enumeration of subjects needing attention he disclosed a veritable mine in which the association can dig with profit for many years to come. The publicity campaign alone is no mean task, and when it comes to standardization, the most aggressive and active work on the part of the association is called for. If the convenience of the user is of any consideration and central stations are to be encouraged to install charging facilities, persistent hammering and blasting at this rock are necessary. A standard charging plug and standard voltage are at present very essential to progress and development in the electric vehicle field, and another important desideratum is the standardization of tires. In the missionary work which inevitably attends all great movements, unanimity in chief essentials is of inestimable worth, and manufacturers might well subjugate competitive interests in these matters for the benefit of the industry as a whole.

Few people appreciate the large number of electric vehicles in operation to-day, the greatest strides having come within the past year or two from improvements in the electric storage battery. In view of the advantages of the electric vehicle, it is, however, astonishing that the public has been so lax in its appreciation. The utilitarian features of the electric vehicle and its superior practicability and economy may have to be proclaimed from the housetops ere much impression is made, and the fund already available for publicity work can be profitably employed in this cause. It is refreshing to note the bright spots presented by those cities where the electrics have established themselves in large numbers through intelligent exploitation of their merits. The examples cited indicate what can be done elsewhere also by similar zealous work on the part of those vitally interested in the sale and upkeep of the vehicles. Battery makers offer encouragement in the shape of improved cells, and the need of lighter electric delivery wagons voiced by central stations will no doubt be heeded by vehicle manufacturers. Taken all in all, the outlook is cheerful. There is much, however, which remains to be taught, but happily there is a growing disposition on the part of prospective users to look into the advantages and economies of the electric vehicle. There is also competition cropping up of no mean proportions in the gasoline field, and it is well for the new organization not to underestimate the strength of the enemy. If the association faithfully adheres to the program already mapped out, its

work will contribute to the stability of the industry and if the enthusiasm displayed at its first convention persists, the electric vehicle is bound to come into its own.

## MORE ABOUT THE FIREFLY.

Elsewhere we print two letters which form interesting contributions to a most interesting subject—the light of the firefly. The letter from Professor Thomson is peculiarly instructive, for it is from the large viewpoint of evolution that many details of natural adaptation may be best seen. Certainly if the light of the firefly plays an important part in the life economy of the species, as its mere existence would render probable, then natural selection would certainly be brought to bear to obtain the monochromatic light which seems to characterize it. The question raised by Professor Thomson regarding the small range of wave lengths visible, which apparently would suggest a waste of energy, has a still further physiological answer to complete the case for the wisdom of Nature. The difference of focal plane in the human eye for red and violet rays is nearly 1 mm, and the only thing to which we owe our ability to get sharp focusing at all is the altogether predominant luminosity of a small region in the center of the spectrum. If this region be cut out and an attempt be made to see by the mingled end rays alone, the result is confusion, the muscles of accommodation hunting in vain for a point of distinct vision between the focal planes for red and violet. If we were able to see the infra-red and the ultra-violet with any distinctness, not only would the different resolving power of the two make trouble, as Professor Thomson points out, but there would be no plane in which chromatic aberration would not hopelessly destroy the sharpness of the image. It would be interesting to speculate on the possibility of the evolution through indefinite time of an achromatic eye system instead of the easier course which Nature has taken in providing predominant luminosity in the yellow. Dr. Coblentz in his letter raises further interesting questions along the evolutional line in dealing with the light given by various species of fireflies. If, as seems likely from his note, some species have a more sharply defined luminous band in the spectrum than others, is there histological evidence of a higher specialization in the light-producing organs, or is it in a sense accidental, due perhaps to secondary causes, like different absorption in the tissues of the creature itself? It is to be hoped that Dr. Coblentz will follow up the investigation he has started, since there seems to be considerable evidence in favor of a material diversity in the light given by various species of light-giving insects.

## GRAPHIC REPRESENTATION OF THE ELECTROSTATIC CAPACITY OF TRANSMISSION CIRCUITS.

As a means of showing most conveniently the relations between two or more interdependent variables, the graphic method possesses certain decided advantages over the analytical. The most prominent of the advantages is the direct representation of the relative effect upon one variable of a change of chosen magnitude in another variable, which effect is somewhat hidden when the relations are expressed in the form of an equation which must be separately solved for each condition assumed to exist. On the other hand, the graphical method can never give absolutely accurate results, while the analytical is subject only to the errors involved in the initial assumptions, and the results obtained are accurate to the same degree that the assumptions are correct. In many practical problems the constants of the involved equations, and sometimes even the forms of the equations themselves, are known with only a fair degree of accuracy, and in such cases graphical methods can be considered equally accurate with analytical methods for the solution of problems. One of the problems that have generally been considered highly complex when attacked by the usual mathematical methods is that relating to the accurate determination of the electrostatic capacity between the wires of a transmission circuit. The familiar expression of this capacity is in the form of an equation involving the logarithm of the ratio of the distance separating the centers of the wires to the diameter of one of the wires. It has long been known that this equation is only approximate in that it gives impossible values when the diameter is very large as compared with the distance between wires. As was first pointed out by Dr. A. E. Kennelly, an absolutely accurate equation for expressing the capacity is found when use is made of antihyperbolic functions. The equation itself is not complex, but Dr. Kennelly in an article elsewhere in this issue has rendered thoroughly simple the representation of the quantities involved by showing them in graphical form. He has also represented in the simplest possible manner the approximate formula applying over the range where its errors are negligible, the graphs of the formula becoming straight lines when the abscissas are plotted to logarithmic scales and the ordinates to a scale of reciprocals. In conclusion we must tender an apology to Dr. Kennelly for wrongly assigning, in a recent editorial, priority to another for the application of hyperbolic functions to electrotechnics. This application was the subject of an article by Dr. Kennelly printed in these columns in 1894; and furthermore, in a paper presented before the American Philosophical Society in 1909, he showed the application of antihyperbolic functions to the computation of the linear resistances, conductances and capacities between parallel cylindrical conductors or between a cylindrical conductor and a parallel indefinitely extending conducting plane.

## WIND AND SLEET IN TRANSMISSION-LINE PROBLEMS.

Few indeed are the problems relating to commercial undertakings that are not affected in some way by the "law of probabilities." The statement just made can be otherwise expressed by saying that in practically all commercial undertakings a certain amount of "risk" is involved. In the erection of transmission lines the law of probabilities is seldom applied, or rather the problems relating to the mechanical features of the lines are usually solved without conscious recognition of any application of the law of probabilities. However, in assigning values to the maximum stresses to which the lines will be subjected, the designer is in reality merely assuming that it is probable to a degree beyond the range of recognizable risk that these stresses will not be exceeded. It is evident, therefore, that the designer should have at hand reliable data upon which to base his assumptions as to the maximum stresses.

Of the stresses encountered in transmission-line problems, those caused by wind velocities and sleet loads are subject to the most uncertain assumption by reason of the scarcity of reliable data. Our present issue contains an article by Mr. Frank F. Fowle giving a comprehensive review of the data re-

lating to wind and sleet obtained from records of the United States Weather Bureau, with particular reference to the Chicago territory. Observations show that during fifteen years a velocity of 75 miles per hour was reached only once, and 85 miles was not exceeded at any time. During nine years the maximum observed precipitation of sleet was 4.5 in. on one occasion. According to the law of probabilities, the assumption that a wind velocity of 85 miles will never be reached while the sleet is 4.5 in. thick involves a risk that may well be considered negligible. From the curves of probabilities given by the author and from estimates of the cost of constructive material, one could determine just what amount of material to employ in order that the risk assumed should be no greater than the cost of the added material to minimize it still further. However, the error would be on the side of safety if the designer assumed always the existence simultaneously of the maximum known wind velocity and maximum probable load of sleet. The law of probability is receiving sufficient recognition when assigning separately the maximum values to the wind velocity and the sleet load. The article by Mr. Fowle is of much importance in giving valuable data relating to these values. The methods for applying these values in transmission line problems have been discussed fully in articles that have appeared in our columns as follows: Aug. 25, Sept. 29 and Nov. 17, 1906, by Mr. Aug. J. Bowie, Jr.; Jan. 12 and Sept. 28, 1907, by Dr. Harold Pender; Feb. 29, 1908, by Mr. W. T. Ryan; March 25, 1909, by Mr. W. J. Glaubitz, and July 1, 1909, by Mr. H. J. Neall.

## STREET SURFACE AND STREET LIGHTING.

The I. E. S. Convention paper of Mr. Preston S. Millar, an abstract of which is printed in another column, brings up many interesting points relating to street lighting. The essential thing to which Mr. Millar directs attention is the very great effect of the street surface on the lighting. This evidently must vary immensely with the actual condition of the street surface, and is particularly affected by some of the recent treatments applied to public ways with the view of lessening the wear and tear. Of course, the condition on upper Seventh Avenue, New York City, which Mr. Millar cites, is not in the least typical of streets in general, but it is none the less interesting. The situation there found was the polishing of asphalt blocks by automobile traffic until the specular reflection became large, so that the images of distant street lights appeared as points of light on the pavement and hence acted somewhat to increase and render uniform the lighting upon the street. On most streets, save when wet, this phenomenon appears to a very much less degree, and on macadam roads, unless treated, hardly at all. Save near grazing incidence the surface of a tarred macadam street is an exceedingly bad reflector, very little if any better than dead black paint on wood. At grazing incidence under favorable conditions there is enough specular reflection to produce a material increase of brilliancy, but roads of this type are such poor reflectors as to be extremely difficult to light as compared with untreated roads or paved streets.

We fully agree with Mr. Millar that the reflecting qualities of street surfaces are highly important, particularly in view of the frequency of asphaltic and similar treatment. A normal macadam surface or a pavement more or less dust-covered, with ordinary blocks, is a very decent reflector, and its effect in brightening the general illumination is very great, particularly when one passes on to it after going along a stretch of asphalted surface on the same street. The latter surface demands from any point of view considerably stronger lighting than the former. Just how much importance should be attached in this connection to the author's theory of silhouetting it is somewhat difficult to say, since while the discernment of objects in general either on the street or anywhere else in a dim light is chiefly due to difference in luminosity between the object and its background, the conditions under which silhouetting from distant lights is of much importance are not altogether common. Large objects may be visible as silhouettes near a distant arc lamp when the street is otherwise in darkness for a considerable distance, but it is not of any particular importance to see objects under this condition. Nobody is much interested in looking at the silhouette of a rapidly departing automobile, and if the car is coming toward him it is by its searchlights and not by its visibility against a bright background that he distinguishes it. When one departs from grazing incidence, the background of an asphalted street is peculiarly bad, and it is often at short range and distant from a light that one has to pick up obstacles in the roadway. The theory of silhouetting therefore furnishes no excuse for bad lighting either near the lamps or far away from them. The more light that reaches the street the better, whether one considers it utilized as a background or as a means of illuminating the objects to be seen.

We are glad to have Mr. Millar directing again vigorous attention to the effect of glare in this connection. A dazzling street lamp is troublesome not only because it produces, as Mr. Millar suggests, a lessened degree of ability to see, due to lessened pupilary aperture, to irradiation, or to too great flooding of the retina with light, but chiefly because the presence of a bright source in the field of view spoils the dark adaptation of the eye which is acquired in moving along a moderately lighted street. The former causes may affect the eye by 10 per cent, 20 per cent or 50 per cent, the latter by many hundred per cent. Even a brief exposure to a powerful and dazzling arc light will put the eye out of condition for seeing faint contrasts in the street beyond for a time much greater than is required for the readjustment of the pupilary aperture. A few seconds at the most suffices for the latter function, while the former will certainly be a matter of many seconds and perhaps minutes. The measurable decrease in ability to see due to the presence of a light source in the field of vision is practically much the least important of the three effects of glare suggested by Mr. Millar. The other effects are not only less transitory but are not avoidable in proportion to the distance of the bright source from the line of vision. One may avoid some of the effects of glare if, as Mr. Millar suggests, there is no lamp within 5 deg. of the object viewed, but a low-hung and dazzling arc will interfere with vision not only when it is well within the field but long after one has passed it. The whole subject is a difficult one since it deals with several totally distinct physiological phenomena in which the absolute amount of light as well as the relative amount plays an important part. Such studies as those of Mr. Millar, however, are of great service in gradually, item by item, bringing to notice details of the theory and practice of lighting which, although they may not have escaped attention, have been overlooked or forgotten by practical men.

## Central-Station Statistics.

The summary of central stations published in the October issue of "The McGraw Electrical Directory" gives for the United States, Canada and Mexico a total of 6180 companies, as against 6055 in the April issue. While the increase is thus 125 companies, there are actually 195 new companies given in the October issue, the discrepancy being due to consolidations and mergers, which were larger than usual during the past six months. The total number of companies for the United States is 5669, as against 5550 in the April issue, with 181 new companies added. There are 3578 companies carrying supplies. The number of municipal plants is given by States for the first time, the total number being 1430. There were 1377 in the April issue. The companies using only alternating current number 3760, while there are but 916 using only direct current. An effort is being made to get information for the directory as to the number of plants supplying steam for heating, as well as of those that manufacture ice. The number of plants so far recorded as furnishing steam heat is 226; those manufacturing ice, 105, besides which there are 122 whose names indicate they may be engaged in the manufacture of ice. There are 159 companies doing a purely transmission business and 1220 using water power. There have been 420 new names added to the directory list of electrical dealers and contractors.

## International Congress of Inventors.

The annual meeting of the International Congress of Inventors was held at Rochester, N. Y., Oct. 20, at which papers were presented by Messrs. Ludwig Gutmann, St. Louis; Henry L. Doherty, New York; Frank Keiper, Rochester; Fred W. Barnaclo, Utica; L. W. Norcross, Fort Worth; Daniel King, Pinkney, Tenn.; John M. Spellman, Dallas, Tex.; G. E. Callaway, Jonesboro, La.; W. J. Paul, Chicago; William J. Brewer, Troy, N. Y.; M. N. Clark, Los Angeles; W. P. Bryant, Corona, Cal.

Mr. Gutmann in his paper advocated a revision of patent statutes and the institution of a lower patent court and a patent court of appeals. Mr. Keiper, former assistant examiner in the United States Patent Office, advocated the appointment of infringement examiners, who, after a summary hearing on a charge of infringement, could issue an injunction, or recommend that the court issue one. He also advocated the requirement that every patentee shall file annually or biennially a report to the patent office showing operation under his patent; the payment to the patent office of a percentage of the profits from his patent, and the assessment of a tax on issued patents of $5 or $10 every fifth year, the fund thus obtained to be used to protect patents. Resolutions were adopted by the congress endorsing Mr. Keiper's suggestions and authorizing the distribution of his paper, with a view to obtaining further suggestions on the subject. The congress also authorized the framing of a bill based on the paper and suggestions received, for presentation at the next session of the Federal Congress, and pledged the Inventors' Congress to use every honorable endeavor to secure favorable action on the bill.

## Decision in Peoria Electric Railway Electrolysis Case.

Judge A. L. Sanborn, of the United States District Court of Madison, Wis., has given a preliminary decision in the Peoria Electric Railway electrolysis case which has been the subject of various court proceedings since 1898, but which actually had its origin in 1894. It was before Judge Grosscup, in Chicago, for some years, then returned to Judge Landis at Madison and finally passed to Judge Sanborn, who in 1907 placed it before a special master for further elucidation. During the course of the suit an immense amount of testimony was taken and many experts pro and con have contributed to the record.

The report of the special master upon which Judge Sanborn acted was that the injury from railway currents to water pipes complained of exists, is permanent and continuing and chargeable to the electric railway company; that the water company can do nothing to prevent the injury; that the railway company can prevent it by the use of double overhead trolley or by any system which provides a completely insulated metallic circuit for the electric current; and that the overhead trolley system, though more expensive to install, has been demonstrated to be as safe, economical and satisfactory in its operation as the single-trolley system.

Judge Sanborn in his opinion states that the injury complained of is localized to the region near the power station, that the damage is decreasing continuously and that the installation of the double trolley is unreasonably expensive, its use dangerous and, moreover, it would not entirely prevent the escape of electric current to the ground. After reviewing the several modern methods of rail-return construction, the court decided that the defendant should be given a reasonable time to take such measures or put in such improvements to its negative return as will substantially prevent injury. The matter of the terms of the decree, as well as the modification of the findings, was deferred for further consideration on application for a decree.

## Georgia N. E. L. A. Section.

At Atlanta, on Oct. 20 and 21, steps were taken toward the formation of a geographic section of the National Electric Light Association, due to the initiative of Mr. John S. Bleecker, who, with the assistance of Mr. W. R. Collier, has been canvassing the State actively ever since the St. Louis convention. The meetings were held at the office of the Georgia Railway & Light Company, and a constitution adopted which follows closely the lines of that of the New England Section. It places the voting power in the hands of the operating companis of the State, while recognizing all the other classes of membership now known in the national organization, which at the present time has in membership in Georgia eleven Class A members and twenty-five Class B members, as well as a few scattering memberships among representatives of the manufacturing and supply houses. The section thus starts out with a good nucleus, and it is believed that the membership can be doubled or even trebled during the coming year.

The following officers were unanimously elected: President, Mr. John S. Bleecker, Columbus; vice-president, Mr. W. R. Collier, Atlanta. Executive committee: Messrs. J. J. Cagney, Macon; R. P. Mayo, Augusta; Burdett Loomis, Jr., Waycross; secretary-treasurer, Mr. H. M. Corse, Columbus.

The proceedings of the convention were most agreeably varied by entertainment on the part of the local electric people. On Thursday a luncheon was given the delegates by the manufacturing and supply concerns, under the auspices of Mr. W. M. Stearns, of the General Electric Company, and on Friday luncheon was given to the whole convention at the Capital City Club by the Georgia Railway & Light Company, whose officers, President P. S. Arkwright, General Manager G. W. Brine, and Mr. W. R. Collier, were indefatigable in their attentions and courtesies. During Friday afternoon the party were also given by the Georgia company an automobile trip around the city to the various plants and other points of interest.

The National Electric Light Association was represented throughout the convention by Mr. T. C. Martin, secretary, who supplied data as to the constitution, methods and practice of the other sections already affiliated.

## Japanese Officials Inspecting American Electrical Works.

A party of Japanese government officials interested in electrical work are on a visit to this country and have inspected a number of electrical plants. The most distinguished visitor is His Excellency R. Nakakoji, vice-minister of the Department of Communication of the imperial Japanese government, which has charge of the State-owned railroads, telegraphs and telephones of Japan. Accompanying him are two secretaries, Messrs. H. Suzumura and S. Uchida. These gentlemen are on

their way home from England and arrived in Chicago last week from Niagara Falls, where they had inspected the hydroelectric plants on Oct. 20. They were met by Mr. J. W. Johnson, manager, and Mr. James Lyman, engineer of the Chicago office of the General Electric Company, and escorted to the headquarters of the Chicago Telephone Company. Here Mr. B. E. Sunny, president, and Mr. A. S. Hibbard, vice-president of the company, took them in charge and showed them through the main exchange. Later the party visited the main operating quarters of the Western Union Telegraph Company in Chicago and witnessed the complementary operation of the telegraph and telephone.

At luncheon on Oct. 20 the party was entertained at the Union League Club, the visitors meeting officers of the companies owning plants visited or to be visited. Mr. J. W. Johnson was the host of the occasion, and in addition to the gentlemen already mentioned there were present Mr. K. Yamasaki, Japanese consul in Chicago, and Messrs. Ishikawa and Nyshiwaki, Japanese electrical engineers temporarily resident in Chicago; also Messrs. Richmond Dean, general manager, and T. Dunbar, manager mechanical department, of the Pullman Company; W. J. Lloyd, assistant general superintendent of the Western Union Telegraph Company; J. G. Wray, chief engineer of the Chicago Telephone Company; G. E. Cullinan, assistant manager in Chicago of the Western Electric Company; John F. Gilchrist, assistant to president, and P. Junkersfeld, assistant to second vice-president, of the Commonwealth Edison Company.

Following the luncheon the Japanese visitors were taken to the Fisk and Quarry Street generating stations of the Commonwealth Edison Company, later visiting the Hawthorne works of the Western Electric Company. On Oct. 21 they inspected the works of the Allis-Chalmers Company in Milwaukee, meeting President Walter H. Whiteside. Returning to Chicago, the morning of Oct. 22 was spent in inspecting the shops of the Pullman Company, while in the afternoon the party witnessed the football game between teams from the University of Chicago and Northwestern University. The visitors left for Seattle on the night of Oct. 22.

## Automatic Telephone Service for Chicago.

Although the plans of the construction company which is installing a modern automatic telephone system in Chicago for the receivers of the Illinois Tunnel Company are being carried out very quietly, an interesting light on the extent of the territory that it is desired to cover was given at the meeting of the City Council on Oct. 17. Alderman Long, of the Sixth Ward, attracted attention to the subject by introducing a resolution calling for an investigation into the proposed use for telephone conduits of streets on the South Side at a considerable distance from the central downtown business district which the tunnels of the Illinois Tunnel Company underlie.

The resolution was referred to a joint committee composed of the three committees on streets and alleys for the North Side, South Side and West Side of Chicago. This action was taken because it is said that the automatic people are planning to extend their system into the outlying districts of the city in all directions, and therefore a large number of aldermen are interested. It is asserted that more than thirty miles of pavement, some of which has been laid only recently, will be torn up if the applications of the tunnel company are granted. The issuing of the permits will be withheld until the matter can be investigated.

The matter has a broad aspect, because the Chicago Telephone Company is operating under a recently drawn franchise giving the city close control. The franchise under which the automatic system of the Illinois Tunnel Company will be operated was granted a number of years ago and is much more general and generous in its provisions, and many of the aldermen seem to think that if there is to be a second general system in Chicago, as indicated by these proposed extensions far from the central business district, it should be under the same close municipal control as the existing company. The subject has therefore a greater importance than that of the annoyance of tearing up the streets.

## Unusual Suit for Damages.

Mr. Leslie L. Davis, of Buffalo, recently brought an action against the Chautauqua Traction Company, of Jamestown, N. Y., in which he demanded $3,000 damages for an alleged accident of unusual character. The case was tried in Mayville, N. Y., on Oct. 13 and 14. The plaintiff was a passenger in one of the cars of the defendant company in Jamestown on July 29, 1909. The car was standing still at the time of the alleged accident, and another passenger got on with a long piece of galvanized iron pipe. One end of this pipe rested against the car controller. The complainant asserted that the other end of the pipe was off the floor, resting against his left leg at the same time that his left foot was touching the "regulator" (probably part of the motor-driven air compressor) under the seat.

The plaintiff was sitting on the back seat of an open car. He alleged that in some manner a current of electricity escaped from the regulator and gave him a serious shock, injuring his health. The theory of the defense was that, assuming all the plaintiff's preliminary statements to be correct, he could only have received a slight shock, which would not have been at all serious. One witness testified that in a conversation the plaintiff asserted that he received a shock from a 2200-volt current. The defense showed that in no event could the voltage have exceeded 550. Mr. Davis testified that the shock had left him lame and that the left leg has become smaller than the right one. Two doctors testified on the part of the defense that they could find no evidence of any ill health on the part of the plaintiff.

John B. MacDonald, of Buffalo, an engineer of the Westinghouse Electric & Manufacturing Company; Alfred C. Jordan, of the same company; George Kohns, assistant master mechanic of the International Railway Company, of Buffalo; David H. Sperry, of Cleveland, and Frank W. Bullock, superintendent of the Jamestown Lighting & Power Company, Jamestown, N. Y., were called as expert witnesses by the defendant. They all agreed that in the circumstances described by the plaintiff he could have received only a slight shock, if any, whereas if the pipe was resting against the regulator, as was at one time asserted by the plaintiff, he would have received no shock at all. After hearing the testimony the jury retired and returned in ten minutes with a verdict of no cause of action.

## Texas Hydroelectric Plants.

The construction of a great reinforced-concrete dam across the Colorado River at a point two miles below Marble Falls and the installation of a hydroelectric plant which will have a capacity of about 30,000 hp are serving to attract attention to the power possibilities of the upper Colorado, the Guadalupe, the San Saba and other rivers that flow through the hilly region of middle western Texas. Already two or three hydroelectric projects similar to that at Marble Falls are being planned and their early consummation is practically assured. One of these is to be located near New Braunfels, on the Guadalupe River, and will be installed and operated by the municipal government of that place. The dam that is to be built across the Colorado River at Austin, thirty miles below Marble Falls, will be of the same type as the one at the latter point of the river.

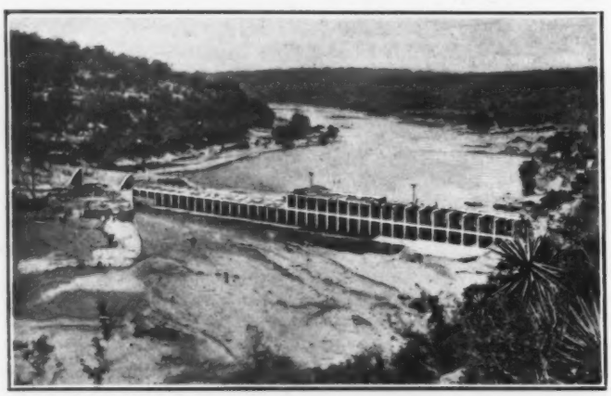
The Marble Falls dam and hydroelectric plant are being erected by Mr. C. H. Alexander, of Dallas, and associates, and the cost of its construction will be about $1,000,000. The reinforced-concrete foundation is embedded in the solid native marble foundation. The superstructure will be four stories in height, making a total height of 65 ft.. Each story is divided into a number of rooms or chambers, separated by 20-in. walls of reinforced concrete. These rooms form a sort of grate work

through which the water may be admitted by means of gates in time of flood in order to relieve the pressure on the dam. The flood gates are of steel.

The base of this dam is 60 ft. wide and the hydroelectric plant will be within the dam. The structure will impound a lake twelve miles long and 1200 ft. to 2000 ft. wide.

The electric energy generated at this plant will be transmitted to a number of towns and cities within a radius of 150 miles, among them being San Antonio, Waco, Austin, Temple, Belton, Georgetown, Llano, San Marcos, Burnet, Taylor, Hutto, Bastrop, Lockhart and Lampasas. It will also be delivered to manufacturing plants and for other purposes in Marble Falls.

Although the dam which is to be constructed across the Colorado River at Austin will be of the same type and size as that at Marble Falls, it will provide for the development of only 6000 hp, all of which will be consumed in Austin. The Austin dam will be constructed by the Hydraulic Properties Company, of New York, which has taken over the contract from the Holmes-Dumont Steel Concrete Company, of Chicago. Under the terms of this contract the city is to pay $1,000,000 for the



Dam at Marble Falls.

construction of the dam and the installation of the hydroelectric plant in semi-annual instalments of $25,000, covering a period of twenty years.

In addition to these two large hydroelectric projects, the early consummation of which is assured, plans are on foot for the erection of other dams and installations of hydroelectric plants, there being a number of available sites along these rivers for enterprises of this kind. In addition to providing electrical generation these proposed dams will store an enormous quantity of water for irrigation purposes.

The construction of an extension of the 'Frisco Railroad from Brady south to Menardville, on the San Saba River, has caused steps to be taken to construct a large dam across that stream with a view of providing water in sufficient quantity to irrigate a large area of valley land, and in connection with the irrigation enterprise a hydroelectric plant will be installed.

## Utilization of Proposed Power Development of Los Angeles Aqueduct.

Los Angeles, Cal., is building an aqueduct 240 miles long to supply it with water taken from Owens River. The volume and head of this water will afford an opportunity for creating a hydroelectric development, with an initial development of 30,000 hp or more delivered in Los Angeles. The question has arisen whether the city shall sell this power to consumers itself or shall dispose of it at wholesale rates to the existing electric service companies to be disposed of by them to the actual consumers, utilizing the existing distribution system. This question was discussed at a public hearing held in the council chamber of the City Hall in Los Angeles on Oct. 13.

Mayor Alexander presided at the meeting and there were many other city officials present, as well as representatives of the electric service companies and a number of citizens of Los Angeles and nearby cities.

President John B. Miller, of the Southern California Edison Company, said the problem before the city was to utilize the proposed supply of electrical energy, making of it an asset with earning power—not a liability or burden upon the city. The problem is not a simple one and is complicated by the existence of the three companies which now give electrical service to the city. These properties represent many millions of investment and employ thousands of men throughout Southern California, and the fate of these investments and of the employment of these men hangs largely upon the city's decision. Mr. Miller expressed his belief in the desire of the people of the city to be fair, and he said that the spirit of his company is one of co-operation and helpfulness. By co-operation it will be possible to obtain an abundance of cheap electricity for the taxpayers without destroying the investments of the companies.

Mr. Walter J. Trask, an attorney, spoke for all three of the companies; that is, the Southern California Edison Company, the Los Angeles Gas & Electric Corporation and the Pacific Light & Power Corporation. He pointed out that the municipal bonds thus far authorized do not include the expense necessary for an electrical distributing plant in the city of Los Angeles or an auxiliary steam plant. To construct these plants would cost from $5,000,000 to $8,000,000. The bonds of the city at present issued and authorized aggregate more than $33,000,000, which is the largest bonded indebtedness incurred by any city of the class of Los Angeles in the United States except Cincinnati.

The speaker also asserted that if the city itself went into the business of distributing and marketing electricity it would have a marked effect on extensions. Los Angeles is growing very rapidly and the extension of electric service to outlying districts has required an expenditure of from $700,000 to $800,000 a year on the part of the companies. If the city should enter the field as a competitor of the companies, the latter would not be justified in extending their systems, but would be compelled to husband their resources and prepare to make the best fight they could to hold the business they now have. This result would be most unfortunate for the development of the city.

The companies have a bonded indebtedness of about $27,000,000, and they pay in city and county taxes more than $1,000 a day. That is more than one-thirtieth of the total amount of such taxes. The companies have expended for distributing systems in the City of Los Angeles about $6,000,000. The city has assumed a moral responsibility toward the companies, and a default on the part of the latter would be a severe blow to Los Angeles, as the companies' securities are held by the leading banks of the city and State, as well as by Eastern banking institutions and the investing public generally.

Mr. Trask suggested the employment of some expert from the East, perhaps from some of the public-utility commissions—a man with practical as well as theoretical knowledge—to act with a board to be appointed to determine what profit the city can make if it constructs a distributing plant, then taking up the subject with the power companies and determining whether a proper adjustment may be made.

Mr. E. F. Scattergood, chief electrical engineer of the bureau of the Los Angeles Aqueduct, was the next speaker. He said that the state of the city's finances must necessarily be considered. It might be wise for the city to endeavor to purchase existing distributing systems at a fair valuation and not proceed to install an independent system unless forced to do so. If the city stands ready to purchase the existing distributing systems at a reasonable price there is no justification in the claim that the electrical energy should be sold to the existing companies.

Mr. Scattergood said that the cost of developing and delivering at a central substation in the city 30,000 hp of electrical energy will not exceed $2,250,000. He remarked that the further cost of a completed distributing system, reaching all consumers within the present city limits and including street lighting, would be about $4,250,000. This system would be capable of taking care of 50 per cent more business than is

connected to the existing distributing systems. Assuming that the city or any single concern with the investment of $6,500,000 mentioned had all the commercial light and power business and the street lighting, but excluding electrical energy required by railways, Mr. Scattergood said that it could establish a 6-cent base rate for electrical energy sold at a rate of $60 per arc lamp per year for street lighting. After allowing for all operating expenses, interest on the investment at 4½ per cent, a sinking fund of 2½ per cent and "proper depreciation," the excess earnings would be something like $700,000 a year, according to Mr. Scattergood. "These results," said the speaker, "are based on conservative estimates, but could not be accomplished with several different distributing systems and several organizations operating to supply the same service."

There were several other speakers, and it was announced that other hearings would be held later. It is probable that the power companies may submit a general proposition to the city. The Mayor is quoted as saying that the question will be decided ultimately by a two-thirds vote of the citizens.

## Mexican Pacific Coast Hydroelectric Plant.

Surveys, estimates and other preliminary arrangements toward the establishment upon the Pacific Coast of Mexico of one of the largest electric power enterprises on the continent have been made. The Mayo River Power & Land Company, composed of Americans, is promoting the big project. According to the authoritative announcement made by the government authorities of the States of Sonora and Sinaloa and the Territory of Tepic, the company has succeeded in financing the enterprise in the United States and the contracts for the construction work will soon be let.

The plans which have been adopted call for the building of three great dams and the installation of that number of hydroelectric plants. These plants will have an aggregate capacity of 300,000 hp, which is about 200,000 hp more than the present capacity of the big hydroelectric plant of the Mexican Light & Power Company near the City of Mexico, although the plans of the latter concern call for the enlargement of its plant to something more than 200,000 hp.

The power-distributing system of the Mayo River Power & Land Company will be very elaborate. It is proposed that the transmission lines shall cover all of the Pacific Slope territory of Mexico, extending from the City of Guaymas on the north to Tepic on the south, a distance of about 700 miles. A number of lines will be built into the mining districts and to the towns and cities, involving all told the construction of about 1200 miles of power transmission lines, it is stated. Tentative contracts have already been entered into by the company with fifteen towns and cities for supplying them with electric light and power. A number of street-railway systems that are now operated by animal traction will be converted into electric transit when the new power is available. One of the most important features of this proposed industrial enterprise is the contract which the company has made for supplying electric power to operate the trains on a portion of the Southern Pacific Railroad of Mexico. It is planned to connect the cities of Guaymas, Culiacan, Mazatlan and Tepic with the hydroelectric plants at the earliest possible time.

The concessions which the Mayo River Power & Land Company has obtained from the State and Federal governments give it the exclusive power rights on the Mayo, the Humaya and the Santiago Rivers. One dam and hydroelectric plant will be constructed upon each of these streams. The surveys that have been made for the proposed dam across the Mayo River in the State of Sonora call for a structure 170 ft. high, 260 ft. long at the top and forming a reservoir of a capacity of 10,280,000,000 cu. ft. of water. The dam across the Humaya River will be 223 ft. high, 708 ft. long at the top and will form a reservoir of a capacity of 11,384,500,000 cu. ft. of water. The dam across the Santiago River will be 215 ft. high, 145 ft. long at the top and will form a reservoir of a capacity of 9,360,000,000 cu. ft. of water.

The hydroelectric plant that the company will install on the Santiago River will furnish power chiefly for the Southern Pacific Railroad of Mexico. Electricity will be used, it is stated, to operate the division of that road which is now being constructed through the Sierra Madres between Tepic and Orendain, the latter place being located on the National Railways of Mexico near Guadalajara.

The Mayo River Power & Land Company has its principal office in Denver, Col., and its representatives have been constantly at work for more than two years locating available power sites and arranging the preliminary details for the project. More than $6,000,000 gold will be invested in the enterprise.

## Modern Election Procedure in N. E. L. A. Branch.

The next meeting of the Commonwealth Edison Branch of the National Electric Light Association in Chicago will be held this month at some date after the twentieth, to be determined. This will be the occasion of the annual dinner and election of officers. There are two tickets in the field, and the nominations were made in a manner characterized by fairness and of unusual interest. There was first a "primary" election. Secretary O. R. Hogue prepared a nominating ballot on a blanket sheet containing a list of all the nearly 600 members of the branch, classified under thirty-one departments, as Accounting, Advertising, Contract, Construction, Engineering, Inspection, Meter, Operating, Overhead, Repairs, Stations, Substations, Testing, Underground, and the like. Space was provided at the bottom of the sheet for nominations for each member for chairman, secretary and three members of the executive committee. Members were instructed not to sign these ballots, but to return them to Mr. Hogue before Oct. 1 without marks of identification. As the result of this election two tickets were made up as follows:

For chairman—Mr. J. W. Ferguson, contract department, and Mr. E. F. Smith, substation department.

For vice-chairman—Mr. O. J. Bushnell, meter department, and Mr. W. C. Davis, Fisk Street generating station.

For secretary—Mr. E. J. Doyle, president's office, and A. E. Evans, substation department.

For executive committee (three to be elected)—Mr. A. D. Bailey, Fisk Street station; Mr. N. J. Conrad, testing department; Mr. E. H. Lakeman, construction department; Mr. Guy W. Lunn, Fisk Street station; Mr. W. P. Lyon, contract department, and Mr. A. S. Turnbull, meter department.

For treasurer, Mr. W. A. Fox, of the company, will be reelected without opposition.

The names of these candidates have been printed on an Australian ballot and one ballot sent to each member, who is instructed to mark with a cross the name of the candidates for whom he votes, returning the marked ballot to the secretary by Oct. 20. Both tickets are strong, and the contest is exciting much friendly rivalry between departments. The election is of more than local interest, because it indicates how an event of this character can be treated to arouse a general and healthy interest in every member of a technical or semi-technical society.

## Dr. Steinmetz on "Electricity."

Dr. C. P. Steinmetz was the guest of the Electric Club of Chicago on Oct. 20, and he selected as the topic for an after-luncheon talk of twenty minutes the broad subject of "Electricity." He said if he were asked the question, "What is electricity?" he would answer after his questioner told him what gravity is. The latter has been familiar for ages; electrical phenomena have been only much more recently the subject of careful study. Our minds are such, said the speaker, that we really cannot reason out the ultimate nature of things. In trying to do so we get tangled up in contradictions.

Electrical energy is that form of energy that has become familiar to us latest. It is convertible into other forms of en-

ergy. We need energy to do our work; to furnish heat, light, transportation; to prepare our food and make our clothing. Everywhere we are consuming energy. Without a continuous supply of energy civilization could not exist.

Energy is not created, of course. It exists in some place and form and time, and there is need for it perhaps in some other place and form and perhaps at some other time. It is the function of the engineer to bring this supply and this demand together. Of the various forms of energy only two may be conveniently utilized, and these are chemical energy and mechanical energy. Chemical energy is represented by fuel and mechanical energy by water-power.

The transportation of energy is required often to make it available. Chemical energy and electrical energy may be transported, the former as in shipments of coal and the latter over wires as in the transmission of electricity. It is an essential advantage of electrical energy that it can be transmitted from one place to another and this characteristic is utilized in the case of water-power developments. It is interesting to remember that we have practically no use for electrical energy as such. Intrinsically, electrical energy is almost useless; it must be transformed into some other form of energy for use; it is useful simply as an intermediate form of energy.

Chemical energy can be converted easily only into heat. Electrical energy has the great advantage that it may be converted easily into other forms of energy as well. Furthermore, electrical appliances designed for the operation of mechanisms may be and are planned so that they may be used by persons not at all familiar with electricity. Thus the motorman of a trolley car need not be an expert electrician, but the driver of a steam locomotive must have an intelligent understanding of the mechanism under his charge.

When the time element in relation to the utilization of energy is considered electricity is placed at a serious disadvantage. Electricity cannot be stored. In the storage battery it is really chemical energy and not electricity that is stored. Electrical energy must be used when produced and produced as needed. Thus, if the customers of a central station were to use all their requirements in two hours it would cost almost as much to serve them for that two hours as it would to operate the station for twenty-four hours. Therefore, the cost of electricity depends on the degree of uniformity with which it is used; in other words, it depends on the so-called load factor, which is the ratio of average use to maximum use.

It follows that electrical energy has not a fixed cost; the cost is a function of the rate of use; it will be high where the load factor is low and low where there is a uniform use—say of twenty-four hours a day, as in the case of some electrochemical industries. Lighting alone results in a low load factor; factory or industrial requirements give a higher load factor. By combining these two demands a still higher load factor may be obtained, resulting in lowering the cost proportionally by utilizing the total investment to a greater extent. It is apparent from these considerations that there is no real fixed limit in the cost of electrical energy either upward or downward.

Large generating stations are undoubtedly more economical than smaller ones, but there is a limit to the economy which may be secured in this manner. It is to be observed, however, that by increasing the load, which makes necessary a larger station, the load factor becomes higher, and it is this fact that enables the price of electricity to be lowered, rather than the economies obtained by the use of the large generating units. Dr. Steinmetz closed by referring to the economy of supplying many varied utilities from a central source of energy, as has been so successfully done in the case of the central-station company in Chicago.

Mr. W. Clyde Jones, a State senator from one of the Chicago districts and a former electrical man, followed Dr. Steinmetz. He reviewed in an interesting manner the development of electrical applications in the last twenty years and under his own observation. He conjectured that possibly during the next twenty years there might be a somewhat similar development in the art of aerial navigation and said that perhaps the Wrights, Curtisses and Blériots of to-day are comparable to the Edisons, Brushes and Bells of twenty years ago. Mr. Jones spoke of the economic phase of the development of chemical and mechanical energy, otherwise the fuel and water-power resources of the country. The question of property rights in these resources is being studied. Practically all the coal and oil deposits in the United States are monopolized by private owners. Water-powers are now being utilized of necessity and the question of the ownership of undeveloped water-powers has assumed great importance. The word "conservation" has assumed a new meaning. The question has arisen whether the national government or the State governments shall take over these undeveloped natural resources. In Illinois this problem exists in relation to water-power development and a commission of engineers appointed by the national government is now studying it, particularly in relation to the waterway and water-power possibilitiies of the Illinois River. "Dr. Steinmetz," said Senator Jones, in closing, "has exhibited the industrial phases of this great question; men like Roosevelt, Pinchot and Garfield are emphasizing its economic phases."

Mr. H. E. Niesz expressed the appreciation of the Electric Club for the pleasure conferred by Dr. Steinmetz's visit, and a rising vote of thanks was extended to the speaker of the day.

## Electricity an Atomic State.

A highly interesting talk on "The Corpuscular Theory of Matter," concluding with a recital of some of the speaker's recent experiments which seem to show that electricity itself exists in ultimate, indivisible atoms or "ions," was delivered by Prof. R. A. Millikan, of the University of Chicago, before the Chicago Section of the American Chemical Society Friday evening, Oct. 21.

After reviewing the basis for the atomic theory as proposed by Dalton, Professor Millikan directed attention to the significance, from the ionic-charge standpoint, of the well-known laws of electrodeposition of metals. For example, it is found that in the transfer of energy through the electrolyte definite weights of the element transported are always associated with definite quantities of electricity passing through the cell, and that these electrochemical equivalents in turn bear a significant relation to the atomic weight and valence of the element involved. Such experiments, familiar for years, should have suggested the indivisible-charge nature of electricity, or, in other words, the latterly proven fact that electrical charges imparted to a body are always in multiple proportion of the ionic charge.

Corroborative data were added to this hypothesis by a study of the phenomena of the Crookes tube, the cathode rays of which, at first thought to be a kind of light wave, were later shown to be actual bombardments of charged particles or corpuscles given off by the cathode plate and moving at such high velocities as actually to give rise to magnetic effects. When it was discovered that these cathode rays might be deflected by traversing a magnetic field all ideas that they were a new kind of mere ether vibration had to be given up, especially as it was later shown that except for proceeding in straight-line paths they were in no sense like light. Precisely similar cathode rays were given off from all kinds of cathodes regardless of their composition, and later it was shown that these same rays could be set up under the action of heat and ultra-violet radiations as well as at the cathode of a vacuum tube. By determining the deflection produced by this corpuscular bombardment traversing a magnetic field it became possible to place the value of the mass of the constituent ions at about 0.0005, that of the hydrogen atom. The ionic charge manifested under conditions of ionization in gases compares exactly with that noted for electrolytes.

Professor Millikan then discussed his recent experiments for measuring the value of the charges of ions by the ingeniously refined method of oil droplets described on page 924 of the *Electrical World* of Oct. 20. The results of many experiments

with the charges acquired by oil droplets of 0.00006 cm to 0.0012 cm diameter, as shown by the speed of movement of these droplets over a fixed distance in an electrostatic field of an intensity of about 6500 volts per centimeter, indicated that the quantity of electricity on the droplet, whether acquired by collision with air ions or by friction in the issuing stream of the atomizer used, was always a multiple of the unit ionic charge, viz., $4.9 \times 10^{-10}$ c.g.s. electrostatic units, which agrees exactly with the results obtained from atomic considerations.

## Electrostatics and Electric Impulse Forces.

At the joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers in Chicago on Oct. 19 Dr. C. P. Steinmetz was the speaker of the evening, and his subject was "Industrial Importance of Electrostatics and Electric Impulse Forces." The main point of the address was to show the comparative simplicity of the electrostatic field if considered in the same manner as Faraday's conception of lines of force in the magnetic field.

The speaker illustrated his remarks, which were of necessity technical in their nature, by simple blackboard diagrams and mathematical equations. He began by saying that the study of electrostatics has become extremely important in the last few years. The first investigations of this subject were made in connection with static machines which give high voltage with low current. Then followed, in the course of electrical development, the so-called galvanism, characterized by moderate amperage and low voltage. When the study of electrical engineering was begun it derived little benefit from the early investigations into the subject of electrostatics. It now became necessary to study the subject of electric power from an engineering point of view and it was found that there was a marked discrepancy between the phenomena of electrostatics as taught in the schools a few years ago and the actual results of electrical engineering experience.

Gradually the transmission of electricity has brought about increasing voltages in commercial practice until now there are underground cables carrying electrical energy at 20,000 volts and overhead lines carrying 100,000 volts or more. The latter figure is higher than the voltage of most electrostatic machines, such as the early writers on this subject had at their disposal. Further, potentials as high as 300,000 volts or 400,000 volts are now used in laboratories, as in the testing of transformers, for instance. These voltages have also very considerable power back of them, which was not the case in the experiments of the early investigators. Thus it became necessary to study electrostatics under new and practical conditions, for problems due to electrostatics are met with on modern high-voltage lines.

It is hard to get a physical conception of the electrostatic field. In the case of the magnetic field an engineering conception of the existing phenomena was given to the world by Faraday and it is the familiar conception of lines of magnetic force. At this point the speaker discussed briefly the complicated magnetic field of the electric generator, where the physical conception of lines of force is of the greatest importance. But when the electrostatic field is reached the trouble begins. Until quite recently this subject was in the same comparatively virgin state, so far as human knowledge went, as were magnetic phenomena in the days before the work of Faraday.

Dr. Steinmetz declared that the same conception of lines of force applies to both the magnetic field and the electrostatic field surrounding a conductor. We can conceive an electrostatic field measured by lines of electrostatic force. In an electric circuit electricity is flowing in the conductor, but at the same time something is going on outside of the conductor. A test by an iron needle shows that a magnetic field surrounds the conductor, and it may be represented diagrammatically by concentric circles surrounding the wire. There is also an electrostatic field surrounding the conductor and the lines of electrostatic force may be represented as radiating from the conductor. In the case of parallel conductors these radial lines are modified so that they may be represented as arcs of circles.

What relation have these two fields surrounding the conductor to the flow of energy within the conductor? For one thing, it is known that they are not proportional to the flow of energy in the wire. The magnetic field is proportional to the current in the conductor and the electrostatic field is proportional to the voltage. It follows that resistance, inductance and capacity are factors of every electric circuit. The magnetic field can exert force; it can do work, and the same is true of the static field, which also can do work. Both fields represent stored energy. To produce a magnetic field energy must be supplied to it. Similarly, the electrostatic field represents applied force. The magnetic field is related to voltage, or inductance, and the electrostatic field to current, or capacity.

To deal with the electrostatic field as simply as with the magnetic field there must be a conception of lines of force, and we may consider the number of electrostatic lines of force per square unit of area. Dr. Steinmetz went into this phase of the subject at some length and explained magnetic and electrostatic flux density and also the saturation point of iron in relation to these phenomena.

There is a saturation value in magnetic materials and electrostatic flux density also causes a certain fixed saturation value. When this value is reached there is no appreciable potential gradient across the electrostatic field. The phenomenon is somewhat analogous to magnetic saturation. The dielectric becomes a conductor at a certain critical point. Usually when this point is reached the surrounding medium, if a solid, is destroyed, and if a gas, it becomes luminous. When the surrounding gases become luminous there exists the phenomenon known as the corona. In the case of parallel conductors each has a range of saturation for its electrostatic field and the resulting phenomena are modified accordingly.

When the electrostatic field goes beyond the saturation value the surrounding space becomes conductive and energy is discharged interminably into it. Theoretically there is no difficulty in calculating all the mysterious phenomena of the corona —no more difficulty than in calculating magnetic phenomena, for the static field presents no more inherent difficulties than does the magnetic field.

In practical application, taking a conductor for a high-voltage circuit, say ⅛ in. in diameter, the saturation value of the static field of such a wire is perhaps 70,000 volts or 80,000 volts. Beyond this limit the phenomenon of the corona is witnessed. If two conductors are near together the corona may be found at 20,000 volts or 30,000 volts.

Any change in the electrical circuit must be followed by a readjustment of the stored energy of the two fields outside the conductor—that is, the magnetic field and the electrostatic field. Every change leads to tension in these two fields. The greatest tension, of course, is between open circuit and closed circuit. If a high-voltage circuit is opened suddenly there will be a successive series of transformations of magnetic fields into static fields and vice versa in the form of oscillations. In the event of a lightning stroke another phenomenon is exhibited, in the case of the circuit, and it may be likened to an electrical impulse or wave progressing along the circuit like a wave in water.

In underground cables the capacity is very high and the inductance is very low. If the impulse or wave passing over the circuit has a moderate voltage the current will be large, and vice versa. If the impulse passes from an underground cable to the transformer it may reach a destructive value while harmless in the underground cable itself. Not infrequently sparks jump across the terminals of inductance apparatus that would withstand the impulse in its interior construction. The electric impulses mentioned may result in almost limitless voltages from circuits with limited voltages and amounts of energy. The problem is to dissipate these impulses into the air harmlessly, as is done by the corona.

The discussion that followed Dr. Steinmetz's address was very brief and concluded with a unanimous vote of thanks moved by Mr. W. L. Abbott.

## Convention of the Electric Vehicle Association of America.

The second session of the Electric Vehicle Association of America, held in the Concert Hall of Madison Square Garden, New York, in the afternoon of Oct. 18, was as well attended as the morning session, an account of which was published in last week's issue. The first paper of the session was read by Mr. Bruce Ford, of the Electric Storage Battery Company, of Philadelphia, Pa.

THE ELECTRIC VEHICLE BATTERY.

The author divided storage batteries into two classes, according to the nature of their electrolytes, and confined his paper to a comparison of the Edison and the lead cell. The characteristics of the lead-sulphuric-acid battery are stated to be high and uniform individual cell voltage on discharge combined with low internal resistance and high watt-hour efficiency. These, the author claims, render the cell peculiarly adapted to the needs of electric vehicle propulsion where high rates of discharge are required for acceleration, hill climbing and bursts of speed. The nickel-alkali-iron cell has a high capacity per unit of weight, which makes it attractive where an abnormal amount of mileage is required per charge. Mr. Ford maintains, however, that the battery is new in commercial operation and that therefore no definite commercial figures have been obtained as yet to substantiate the claim for long life. High internal resistance and high initial cost are given among the disadvantages of the alkali-iron cell. In the present standard type of lead cell the capacity per pound is varied within certain limits by furnishing plates of different thicknesses. A thicker plate has a longer life in number of cycles of charge and discharge than a thin plate; but its capacity per pound on each discharge is not so great. The author described three thicknesses of plate, one with an initial capacity of about 8 1/3 watt-hours per pound of complete cell which increases to about 10.5 watt-hours in service; another having an initial capacity of about 9.25 watt-hours per pound of complete cell which increases to about 12 watt-hours in service, and still another with an initial capacity of about 10 watt-hours, increasing to about 13.25 watt-hours. Experience has demonstrated that the life in miles of thin plate batteries is about the same as that of thick plate batteries, it being understood that there are more plates per pound of thin plate battery than of thick plate battery. The author states that in both the lead and nickel types of battery the action which governs the life is largely mechanical, the alternate action of charging and discharging causing a molecular disturbance which results in the loss of coherence of the active material. In the lead battery it has been the practice to permit the active material to become gradually disintegrated and washed out from the surface, and to allow a reserve in the quantity of active material sufficient to produce a commercially satisfactory life. To the carrying around of this reserve active material is attributed its great weight per unit of capacity as compared with the alkali battery, whose active material is maintained mechanically to restrict its molecular disintegration. Mr. Ford informed the meeting in closing that his company has purchased the American rights to a French patent covering a method for preventing the disintegration and washing away of the active material of the lead cell, and has been experimenting with the improved battery, which in its present form gives an initial capacity of about 9.5 watt-hours per pound, which increases to over 13 watt-hours in service. Moreover, the life of the battery is claimed to be from two to three times that of the present type of lead battery and during its life the necessity for cleaning the battery of sediment is eliminated. No details of the battery were vouchsafed, the author confining himself to the mere announcement.

Mr. Ford's paper was followed by a very practical paper dealing with the care of the lead cell, prepared by Mr. S. C. Harris, of the battery department of the New York Edison Company. An abstract of this paper appears elsewhere in this issue.

THE CENTRAL STATION AND THE ELECTRIC VEHICLE.

Mr. Frank M. Tait, in a paper entitled "A Central-Station Campaign for Electric Vehicles," considered the subject under the heads of "The Pleasure Vehicle" and "The Commercial Vehicle." It was stated that a net flat charge ranging from $25 to $30 a month for the average coupé or victoria runabout is about the proper rate for a garage charge, but this does not include any tire or general machine repairs. A satisfactory rate for selling electricity to a public garage is 4 cents per kw-hour net, with a minimum service charge averaging $5 per month for each charging rheostat connected. In the case of a private garage a net meter rate of 6¼ cents per kw-hour, with a minimum service charge of $5 net per pleasure vehicle per month, seems to be satisfactory. Taking up the question of the commercial vehicle, he stated that to sell electric trucks a central station must first have a truck or two of its own, an equipment for charging and handling electric trucks, and men in its employ entirely familiar with battery equipment to look after the garage. A plan to interest a possible purchaser is to offer to loan a truck and competent driver to go over the routes now covered by horse deliveries, and allow the deliveryman to check the truck's cost record, as the showing will always be in favor of the electric truck, unless the work to be done involves long and continuous hauls into the country, etc. The paper includes illustrations of a number of commercial vehicles in service in Dayton, Ohio. In the case of a 3000-lb. beer wagon it is stated that the owners have operated it regularly for the past three years on one set of batteries, to which nothing was done except that they were inspected every six months and new plates then inserted if necessary. The batteries were fully charged every night, and the wagon was on the street ten hours every business day, carrying loads ranging from 2500 lb. to 3500 lb. Mr. Tait recommended manufacturers to consider the supply of a small electric wagon of from 500 lb. to 750 lb. capacity, to come between a pleasure vehicle and a 1000-lb. truck, and which could be furnished to the central station for a very much lower price than the latter. He states that there is an eager demand for such a "small service" vehicle. At present the central stations are handicapped by the use of small gasoline delivery wagons of this capacity, as the only electric vehicle now available for the purpose is a 1000-lb. electric wagon, which has a first cost of 65 per cent more than the average small gasoline delivery wagon.

*Discussion.*

Following Mr. Tait's paper discussion was opened on all of the papers which up to that time had been presented.

Mr. Hayden Eames, of Cleveland, called attention to the fact that the dominating note of all the papers read was the education of the public, the introduction of the electric vehicle depending on that rather than on engineering advance. The fool-proofness of the outfit should be emphasized, he said, and the owner advised that the high points of care can be taken up by the central stations. It was just as important in his estimation for one to know how much the battery can be neglected intelligently as it is to know how to care for it scientifically. The vehicle, if it is to be widely adopted, must be convenient; and to be convenient the owner must be relieved of the battery supervision. He cited instances where women charged the battery when they liked and not when the battery should have been charged. The result was that the battery was never overcharged and once a month the garage attendant gave it a full charge so that the battery never suffered.

Mr. Conant, of Washington, D. C., voiced the desirability of a standard charging plug as mentioned in President Blood's address and suggested that a committee be appointed to look after the matter. Mr. Blood said that the charging plug would with other matters be given over to a committee after the convention adjourned.

Mr. R. M. Searle, of Rochester, N. Y., commented on the admission that electric vehicles are not suitable for long hauls, and said that it was necessary for central station men to cry down this confession of weakness. He cited instances where by the installation of grade trolley lines for automobiles in New Jersey and in the Westchester district of New York deliveries could be made by New York merchants in territories now im-

possible owing to the hills encountered. The installation of shock absorbers, he said, would also do away with 90 per cent of the chain snap, battery jolt and tire wear; but thus far these devices, so much used in gasoline machines, have not been applied to electric machines. He informed the gathering that from a conversation he had with Dr. Snevin, just returned from Europe, a combination of synthetic rubber and bakelite is destined to solve the rubber tire problem in a short while. Mr. Searle also pointed to the fact that the gasoline car and all its accessories have been placed in schools of technology for the instruction of students, whereas the electric vehicle is unknown in such schools. As a help to those selling electric vehicles, he intimated that if while the vehicle is on trial a number of photographs be taken and presented to the prospective buyer much good will result.

Mr. Sands, of Boston, agreed with Mr. Tait in the necessity of a lighter electric vehicle. He said that Mr. Eames in his St. Louis paper placed the burden of electric vehicle introduction on the shoulders of the central stations. The manufacturers, he maintained, ignored the field for a lighter vehicle, notwithstanding that requests have been made for them time and again. The most potent argument against the commercial use of the electric vehicle of the present type, he said, is the fact that central stations themselves do not use it.

Mr. Lloyd, of Philadelphia, referring to Mr. Ferguson's paper, asked if the energy rate was the same for electric vehicles as for elevators, and if the load factors of the different classes of business were considered. In reply Mr. Ferguson said that he had not gone into the rate question in his paper because it was too complicated. The rate for elevator service in Chicago is about 7.5 cents, while batteries are charged at about 5 cents a kw-hour. The load factor of an elevator installation, however, is about 5 per cent, whereas the load factor of a vehicle installation is from 30 per cent to 35 per cent.

Mr. E. Lunn, of Chicago, gave the reasons for high charges made for washing batteries in garages. In many instances the batteries are not properly assembled and the user is negligent in flushing the battery properly and in washing it at the proper time. Therefore the separators become damaged and considerable charging is necessary to bring the battery back to its proper condition. He contended that there were limitations to the design of light delivery wagons which would make them of doubtful value commercially.

Mr. Farley Osgood, of Newark, N. J., cited some reasons, such as long hauls and steep grades, which made the introduction of electric vehicles in the State of New Jersey on a large scale problematical. He saw aggressive competition on the part of second-hand gasoline cars fitted for light delivery service. These cars can be bought at low prices and remodeled and it would be difficult for an electric to compete, at least as far as first cost is concerned. He had heard that while several electrics were an advantage a single electric truck was not, and wished to be informed on the matter as well as on the merits of solid and pneumatic tires. His impression was that the solid tires were more costly in operation than the pneumatic tires.

Mr. Arthur Williams, of the New York Edison Company, related a conversation he had with Mr. Edison in which the latter maintained that what the butcher and grocer need is a small vehicle capable of traveling twelve miles a day or at most twenty. Such a vehicle would have a small motor and small battery and should cost about $750. Mr. Williams pointed out that electric vehicle charging is not a peak load, whereas elevators are. The long-haul problem, he said, was solved in New York by night delivery service to local distributing stations. The ability to deliver goods promptly and creditably is one of the most important features in favor of the electric vehicle. He said that a large department store manager told him that central-station men were too modest in their praise of the electric vehicle and that they did not claim anywhere near that degree of excellence in service or efficiency which the vehicle is entitled to. Electric vehicles were the only ones which performed their work satisfactorily. The customer selects the roads and not the fellow who drives the car, and the electric is the only car which will withstand the strains of general delivery work. One of the experts of a department store delivery service told him that last winter a 2000-lb. wagon averaging thirty-six miles on its route cost 40 cents a day and displaced four horses on the road and four in the stable. Mr. Williams said that a solicitor could make all the claims made for any other type of vehicle for the electric and that the electric would make good in service.

Mr. Ferguson, replying to Mr. Osgood, said that one truck gave as good service as many when properly handled. The trouble, however, is that an individual with only one truck does not employ an expert to look after the battery, whereas a concern with many vehicles gives them expert attention. Central stations could offer some remedy for the trouble, or, better still, battery manufacturers, by building a foolproof battery. As to tires, Mr. Ferguson's experience with his own gasoline touring car is that pneumatic tires cost him 7 cents a mile, while the experience of the Commonwealth Edison Company in Chicago is that solid tires cost it 1.45 cents per mile.

Mr. Lloyd, of the General Vehicle Company, Long Island City, said that small wagons would be produced if there were a market for them. Light-weight cars must be made in quantities to be commercially possible. Pneumatic tires, he maintained, were more expensive than solid rubber tires and a person with a single electric vehicle is much better off than a person with a single gasoline car. He gave the experience of his company in looking after all its vehicles throughout the country.

Mr. Hayden Eames said that the call to-day was not for small but for large electric vehicles, manufacturers finding that they can carry bigger loads. Mr. R. M. Searle, on the other hand, maintained that a small delivery wagon is sorely needed. If the manufacturer of commercial electric vehicles would not meet this need, then the manufacturer of pleasure vehicles could do so by placing a delivery wagon top on a pleasure vehicle chassis.

Mr. Kennedy, speaking on the cost of solid versus pneumatic tires, claimed that the solid tire costs less than 1 cent a mile. The tire cost increases with the square of the speed and by reducing the speed the tire cost is greatly lessened. He also said that there are a large number of single electric vehicles in use which are giving satisfaction. Shock is being minimized by the spring suspension of the battery and by equipping vehicles with larger wheels. Mr. Morgan, of New York, and Mr. Day Baker, of Boston, gave experiences in cleaning batteries and on the tire problem.

Mr. Osgood asked how many miles a day an electric vehicle would have to cover in order to make its operation cheaper than delivery by horse-drawn wagons. Mr. Lloyd, of Long Island City, said when an electric covers fifteen miles it is as cheap in operation as a horse-drawn wagon. Mr. Ferguson said that at twenty-five miles a horse-drawn and an electrically propelled vehicle are comparable, while there is an indirect saving possible with the electric in addition. Mr. Searle said that Mr. Osgood virtually asked how to sell an electric vehicle, and he proceeded to tell the questioner how they were sold in Rochester. The vehicles are put out on 30, 60 and 120 days' trial and the results carefully tabulated. He said that is all that is necessary usually to effect a sale in cases where an electric vehicle is at all applicable.

A paper by Mr. G. M. Graham, of the Philadelphia *North American*, was next presented, followed by an announcement by Mr. Duncan Curry, of the *New York American*. Mr. Graham told of the preliminary work performed by his journal in connection with the first commercial vehicle run ever given in this country, that from Philadelphia to Atlantic City and return, the result of which was published in our Sept. 1 number. Mr. Curry simply stated that his journal would conduct a commercial vehicle test in New York on Oct. 28 and 29.

DEPARTMENT STORE GARAGE.

In a paper entitled "The Largest Modern Electric Garage" Mr. Charles L. Eidlitz described the garage of Gimbel Brothers, the new large New York department store. The building is two stories in height, with a frontage of 150 ft. and 100 ft. in depth, and is of brick with concrete arches and floor, thus

making it fireproof. The first floor is devoted entirely to charging, there being 595 hp in charging equipment for ninety vehicles. The electricity for charging, lighting and power is furnished by the United Electric Light & Power Company, 220-volt, two-phase current being supplied for power; 120-volt, single-phase current for lighting, and 75-volt and 120-volt direct current for charging. The service board is 10 ft. long and 8 ft. high. The main board is 30 ft. in length and, including rheostats, is 13 ft. in height. It consists of thirteen slabs, having a total of seventy-eight switches controlling circuits which are capable of charging seventy-eight vehicles at one time, thirty-six at 75 volts and forty-two at 120 volts. To charge, the operator first throws a switch to the left, inserts a potential plug, reads the meters, operates his rheostat and then throws the switch to the right. When the battery is fully charged it rings automatically on an annunciator at the board, the switch is opened and an attendant notified by telephone to uncouple. It is pointed out that, whereas the space that would be required for horse stalls would be valued at $150,000, that necessary for the electrical equipment of the garage amounts to only $2,340.

*Discussion.*

Mr. E. S. Mansfield, of Boston, spoke of the need of garages having charging facilities and complained that all of the missionary work connected with the introduction and care of the electric vehicle is put on the central stations of the country.

Mr. F. W. Smith, of New York, said that the garage just described showed what would be considered proper equipment for an installation in a large city. The fact that the garage is used in connection with a New York department store is merely incidental, its size being such as to make it an excellent model for garages intended for general vehicle use.

Mr. P. D. Wagoner, of Long Island City, called attention to the excellence of the garage in question and, replying to Mr. Mansfield's contention that the burden of the missionary movement was on the shoulders of central stations, cited the case of his company, which maintained garages in New York City. He commented on the large number of central stations compared with the small number of electric vehicle manufacturers and spoke of the immense investment that would be necessary for the few electric vehicle manufacturers to establish charging facilities all over the country. Mr. Wagoner gave some figures on electric vehicle performance in New York, where four electrics in their third year of service were compared with four gasoline vehicles.

Mr. Turner, of Cleveland, said that in his city there are from 1500 to 1600 electrics in operation, and that the garages are maintained by the electric vehicle manufacturers.

After hearing the report of the committee on the president's address and passing a vote of thanks to the New York Edison Company for its hospitality, the convention adjourned.

## Introduction of the Electric Vehicle.

At a meeting of the Electric Vehicle and Central Station Association held in the Edison Auditorium, Boston, Oct. 17, Mr. Edward S. Mansfield, of the Edison Electric Illuminating Company, of Boston, gave an address, illustrated by stereopticon, entitled "The Electric Vehicle Proposition." The author presented in detail the advantages of the electric vehicle both for pleasure and trucking, and pointed out the various means by which its introduction could be advanced. At least one garage should be established in every city and town where electrics are in use, or where they could be sold if a garage were installed; an efficient inspector should be appointed to see that electric garages give the best of service, to inspect batteries in private charging stations and to educate the caretakers in the simple rules of battery charging. A standard form of charging plug should be adopted, and also an official form of charging sign. An official list of charging stations should be compiled and corrected from time to time, and be available for distribution to electric vehicle owners and prospects. A committee should be appointed by the association for the purpose of standardizing terms and usages, and also forms of records for public and private garages. A bureau of information under the publicity department would be valuable in extending business, as a prospect would feel that from such a source he would receive impartial information.

Mr. Mansfield believes that the affairs of the association should not be dominated by the selling interests, but that the electric vehicle owner should be eligible to membership and have a generous representation. Concerning central-station rates, the prospective customer must not take it for granted that such rates for charging are so high that he cannot afford to buy an electric, as a talk with the company's agent may prove to him that the rates, in fact, are particularly attractive: and he must also understand that the cost of current is a small item compared with the greater saving in the use of electric vehicles.

## Commercial Electric Vehicles.

In a paper entitled "Commercial Electric Vehicles," read before the Boston Company Section of the National Electric Light Association on Oct. 18, Mr. E. S. Mansfield stated that in Greater Boston there are 176 pleasure vehicles and 55 electric trucks, with some 30 or 40 private and 25 public charging stations. The ratio of electric to steam and gasoline vehicles is there 1 to 26. On the other hand, in the City of Cleveland there are 1006 electric pleasure vehicles and 24 electric trucks, with 596 private and 14 public charging stations, the ratio of electric to steam and gasoline cars being nearly 1 to 4. The way in which a central station can effectually build up an electric vehicle business is to establish a competent automobile department to educate the public to the possibilities of the electric vehicle when properly applied and intelligently cared for. Until the public becomes educated in the use and care of the battery a system of education and inspection is essential to its efficiency and life. Much credit is given to the work of the lead battery in the past, but it is stated that with the latest Edison battery a new era has been reached, as this battery gives longer life, greater distances on a single charge, a reduction in weight of battery and vehicle, and is proof against carelessness never before realized or dreamed of.

Where the same use is made of the gasoline and electric vehicle the latter shows a decided advantage, both in maintenance and operation. There is a considerable saving in tire maintenance of the electric over gasoline vehicles, owing to the better acceleration of the electric. The electric through its ideal control gives an appreciable saving of time in congested districts, and its life is from two to three times that of the gasoline machine, due to quiet running and lack of vibration. No extra rate of insurance is imposed on the electric, or on the building or shed where it is housed, and it is admitted to railroad depots and freight yards and on steamboat docks, from which the gasoline truck is excluded. An instance was cited of a 1000-lb. electric wagon's operation during a period of four years, which had a repair account amounting to exactly 30 cents, aside from the case of a spring broken in passing over a bad piece of road.

At the present time there are over 36 central stations in the United States using electric vehicles. The New York Edison station has 72 electrics of various types and sizes in daily operation. Results of operation show that in the case of Macy & Company, in New York, horse-driven vehicles cost 8 2/5 cents per package for delivery, while electrics cost but 6 2/5 cents per package. The cost per mile with a light electric vehicle was 5.9 cents. A central station company in one of the larger cities has 31 electric vehicles, ranging from 300-lb. to 3½-ton trucks, which in the month of June made a total run of 42,000 miles, with an energy consumption that averaged materially less than ½ kw-hour per mile, the vehicles running from 27 to 50 miles on a single charge. Figures for a period of a year and a half showed a cost per mile, covering all charges excepting administration expenses, as follows: 350-lb. capacity, 12 cents per mile; 1000-lb. capacity, 19.6 cents per mile; 2000-lb. capacity, 21.5 cents per mile; 4000-lb. capacity, 29 cents per mile; 7000-

lb. capacity, 40 cents per mile. In the case of a large brewery the cost of transportation with horses was 34 cents per barrel, which was reduced by the use of electric trucks to 27 cents per barrel. This company has ordered a large additional equipment, and states that it expects to save $20,000 a year when deliveries are made entirely with electric trucks. Another large brewery which has twelve electric vehicles in service estimates the cost of operation to be about 14 cents a mile. There are 62 breweries in the United States at the present time using electric trucks.

## Coal and Copper Mining in Alaska.

Mr. Alfred H. Brooks, geologist in charge of the Alaskan work of the United States Geological Survey, has recently summarized the coal situation in Alaska in Survey Bulletin No. 442, pointing out the importance of making the high-grade fuels found there available for the use of both Alaska and the Pacific Coast States. While the coal is of first importance to Alaskans, who are attempting to develop the various great resources of the Territory, it is also of scarcely less national importance, inasmuch as these fields can furnish fuel to the industries of the Pacific Coast States and to the Pacific fleet. The development of these fields will conserve the coals of the eastern part of the United States, which are of most value to the nation because they are nearest the center of population. The manufacture of iron on the west coast, for which there is abundant raw material, utilizing Alaskan coal, will not only cheapen the product by overcoming the long railroad haul or the trip around the Horn, but it will diminish the drain on the Eastern iron and coal fields. Every shipload of coal carried around the Horn consumes about one-fifth of its own cargo, while the hauling of iron and coal over the Rocky Mountains results in a still greater fuel waste.

In spite of the low price of copper there has been much activity, Mr. Brooks states, in prospecting for this mineral in Alaska, and seven or eight mines in three districts have continued to make an output. The inland copper districts can only be developed by the construction of railroads, and these depend for their success on the securing of cheap coal.

## Northwest Station of the Commonwealth Edison Company.

A visit to the site of the projected Northwest station of the Commonwealth Edison Company shows that work on the elevated switch-track railway, which is to connect the new generating station with the tracks of the Chicago & Northwestern Railway Company, is proceeding steadily. The principal portion of the site extends about 1400 ft. west from the North Branch of the Chicago River, and is bounded on the north by Addison Avenue and on the south by Roscoe Street. It extends as far west as Elston Avenue, and is conveniently reached by the Elston Avenue car line. It is about six miles northwest of the center of the "downtown" business district of Chicago, in an air line.

Plans are under way for the erection of a 120,000-kw generating station on this site, having six turbo-generator units, rated at 20,000 kw each. After the first station is built the present plans contemplate the erection of a second one near the first and duplicating it in design and size. Nothing has been done as yet on the site of these great power houses, which will have the largest electric generating units in existence, beyond the driving of a few piles for testing purposes. Present activities are confined to the building of the elevated railway which will connect the stations to the Chicago & Northwestern tracks. This railway will be electrically operated.

A near neighbor of the great Northwest station will be the existing power house of the Chicago Consolidated Traction Company, at the corner of California Avenue and Roscoe Street.

## Telephone Service in America.

At the International Telephone and Telegraph Conference, held in Paris Sept. 4-11, Mr. John J. Carty, chief engineer of the American Telephone & Telegraph Company, presented an interesting paper entitled "Telephone Service in America." The paper was a discussion of the subject of automatic versus manual switchboards, but gave much information concerning recent telephone development in this country, particularly in New York City.

After discussing the main features of the automatic switchboard system, the conclusion arrived at was that this system is not, in fact, automatic but only partly so; that it has been fairly and exhaustively studied and found to be unsuitable for the comprehensive demands of present service, and more and more unsatisfactory when considered with respect to the demands of the future. Some years ago a careful study was made with a view to ascertaining how far the automatic system might be advantageously used in New York City at that time. It was then found that, counting private branch exchange operators and central-office operators, the so-called manual system would require 13,000 operators, while the so-called automatic system, leaving out of account the "mechanician operators," would require 10,000 operators. A thorough study was also made of the telephone system of the State of Connecticut, which showed that, at the time the study was made, if all of the private branch and other operators needed with the manual system were counted, a total of 892 was required. A similar careful study showed that if the automatic system were installed 600 operators would be needed, not counting the "mechanician operators." These illustrations showed that the automatic system, which has so many alluring features about it when its application to simple conditions is considered, becomes more and more unsuitable as the plant grows. Even when the automatic system is applied to the simple case of a single office district, an instance is not to be found in which the total annual charges rendered against it are less than for the manual system.

The paper sketches briefly a semi-automatic system which has been developed and is now being installed in New York for an experimental demonstration. In this system the subscriber's station is identical with that employed in the so-called manual system. The pieces of automatic apparatus needed at the "A" operators' positions in the central office (the "A" operator is the one who answers the subscriber in the first instance) are relatively small in number, while all of the "B" operators (the "B" operator is the one who receives the trunk call from the "A" operator at another office) are eliminated and machines substituted. This semi-automatic system will employ an apparatus operated by keyboards similar to that used on a typewriter, and with such a keyboard it has been experimentally demonstrated that an "A" operator can handle a very much greater number of calls than she could in the so-called manual system, which fact materially reduces even the number of "A" operators. Mr. Carty stated that soon after he returned to America he hoped to be present at the opening of a semi-automatic switchboard, and that if the expectations regarding it are realized, it will be a system more efficient and more economical than either the so-called manual or so-called automatic.

Mr. Carty said that in New York it has been found most economical to make plans for work for a period of twenty years. These plans are not speculative, but are followed in the construction done each year, putting down not only that which is needed for to-day, but that which most careful study represents will be required during a period of twenty years. With such plans for a given city, the probable conditions of the plant are studied at each period of its growth. With such a guide a switchboard or other system, however suitable it might be at the moment, is not installed that will not be capable of growing into that form and to that magnitude which would be required of it by the conditions which must be encountered before its life has expired.

Some idea of these conditions in New York was obtained

from the following data: The fundamental plans for that city, not including the vast outlying suburban regions, provided in 1900 for a system of 51,398 telephone stations, served from forty-three central offices, the population of the city being estimated at 3,437,000. In 1910 the plan provides for 376,000 telephone stations, served from fifty-two central offices with an estimated population of 4,800,000. In 1930 the plan provides for 2,142,000 stations, to be served from 109 central offices, with an estimated population of 8,300,000. Referring to long-distance service Mr. Carty stated that there is an effective long-distance service, through underground cables of the Pupin type, from New York to Philadelphia, ninety miles, and good talking with trunk connections is an everyday matter between New York and Boston, 235 miles. At the present time an underground cable of the Pupin type is being extended from New York to Washington, 225 miles, and surveys and plans are being made for an extension from New York to Boston. By the adoption of phantom-loaded overhead circuits between New York and Chicago, and by similar extensions westward as far as Omaha, and thence to the Rocky Mountains, it is expected by Jan. 1 to extend the long-distance frontier so that conversation may be held between Denver, Col., and New York City, a distance of 2200 miles.

## Baltimore Convention of the Illuminating Engineering Society.

With an attendance which overtaxed the meeting room in which it was held, the fourth annual convention of the Illuminating Engineering Society was opened in McCoy Hall at Johns Hopkins University, Baltimore, on Monday, Oct. 24. The convention served the double purpose of bringing together various persons interested to discuss papers on illuminating engineering prepared for the occasion and of forming the introductory exercises connected with a highly noteworthy course of lectures on illuminating engineering offered by Johns Hopkins University in co-operation with the Illuminating Engineering Society. The registration on the first day was 136 members, 24 ladies and 24 guests, or a total of 184.

### ADDRESSES OF WELCOME.

The address of welcome to the city was delivered by Hon. J. Barry Mahool, Mayor of Baltimore, who called attention to the effect of illuminating engineering on Baltimore, the lighting of some of the streets of which is excellent. He remarked that much is now being done toward beautifying the city, particularly with reference to the streets, along which all the electric wires are being placed underground.

Dr. Ira Remsen, president of Johns Hopkins, welcomed the society to the university. He stated that among the "first" things for which Baltimore is noted mention should be made of the offering of the first organized course for graduate students, the first requiring the degree of preparation for medical study which is now being adopted by the leading medical schools, and the first offering a course in illuminating engineering. He paid a touching tribute to the memory of Prof. Rowland, whose ashes are now kept in a vault two stories below the surface near the machine upon which was done his work with diffraction gratings.

Following the addresses of welcome, Dr. E. P. Hyde, president of the Illuminating Engineering Society, delivered the annual presidential address, while Past-President Sharp occupied the chair.

### PRESIDENTIAL ADDRESS.

In his presidential address Dr. Hyde discussed the goal of illuminating engineering, which, he said, was the attainment of the ideal application of perfect knowledge. He remarked that, judged according to our present conception of ideality, the ideal artificial illuminant, apart from any consideration of its form or magnitude, its polar diagram or its intrinsic brilliancy or any other of its numerous attributes except the quality of the light and efficiency of its production, would transform all the energy supplied to it into luminous radiation of sunlight color. If all of the energy supplied to a lamp were transferred into radiation and all the energy radiated were confined within very narrow limits of wave-length in the yellow-green region of the spectrum, it would be possible, according to the best data available, to produce a luminous flux of about 800 lumens for every watt supplied. However, this monochromatic light would be unnatural and the appearance of natural objects illuminated by it would be uncanny. If, however, the second condition were modified so that all the energy was radiated, not within the narrow wave-length limits of a single color, but throughout the visible spectrum, the distribution of energy in the various colors corresponding to that of average daylight, the resultant light would match daylight in quality and would correspond to an output of about 300 lumens per watt, which is five or six times that of the most efficient artificial source of the present day. Such an efficiency is impossible in the pure temperature radiation of a black body and is scarcely to be sought in the pure temperature radiation of any solid, however selective its radiation may be, for no substance is known which indicates even the possibility of such extreme selectivity.

If an output of several hundred lumens per watt is ever to be attained it should be sought in the radiation of so-called luminescence as exemplified in the flame light of the various luminous and other arcs. A characteristic of such luminescent radiation is a discontinuous spectrum, and even though the desired efficiency might be obtained it is improbable that the bright line spectrum would consist of so many lines and of such relative intensities that the integral quality would be that of sunlight and that the color of natural objects would be true.

Even if it were possible through the development of physical science to produce a light source of the quality of daylight and with the highest possible efficiency consistent with this quality it is very questionable if the results would be perfect. Life upon this earth, as we know it, is dependent on the warming influence of the solar radiation, much of which is beyond the limits of the visible spectrum, and yet one of the conditions of the ideal source precludes any radiation except in the visible spectrum. Many destructive and constructive organic chemical processes are attributed to the ultra-violet radiation in daylight, and yet one of the conditions of the ideal artificial source implies the exclusion of ultra-violet radiation. The demands we have made upon the ideal artificial source render it unnatural and no one knows the bane or blessing involved in those very radiations which one should studiously avoid.

Efficiency signifies in its broadest meaning the most perfect accomplishment of some desired end by the most economical means. It is the ratio of satisfactoriness to cost and not merely the reciprocal of cost. If the aim of a lighting design is a soft yellow tint, a green light would not be efficient, whatever its lumens per watt. It is correct to study the source as a necessary element in illumination, but the emphasis to-day should be placed rather on the study of its application. Although the most efficient source possible as a result of the evolution of scientific research may not yet have been developed, numerous sources are available which have not been utilized to the limit of their possibilities. Until the fundamental auxiliary sciences which underlie the science of illuminating engineering attain to perfection, that science cannot be perfect; the development of the science of illuminating engineering is not even abreast of those auxiliary sciences on which in large part it depends.

Dr. Hyde expressed the opinion that the assumption that a uniform distribution of illumination is to be desired in interior lighting is hardly justified. He stated that our knowledge is relatively meager on the values of high lights and shadows, and of directed and diffused illumination; our knowledge of exact conditions in the case of daylight illumination, which are generally recognized as highly satisfactory, is very deficient and the result must follow that with less satisfactory illuminants and with imperfect knowledge our attempts at artificial reproduction of these daylight standards meet with but a small meas-

ure of success. Illuminating engineering as a distinct science is, indeed, not abreast of those auxiliary sciences on which it in a large part depends. To an even greater degree it may be said that the art of illuminating engineering is not abreast of the development of the material illuminants which it applies. It would seem from the above that we have at the present time very indefinite conceptions of ideality in what might seem to be the simplest and most advanced elements of illuminating engineering.

The goal of illuminating engineering is not the mere computation of foot-candle illumination necessary for vision or the design and application of lamps and reflectors which will give a uniform or non-uniform distribution of illumination, as the exigencies of the case or the whim of the designer may dictate. It is not a cold calculated plan of illumination which keeps within the bounds of physics and does not trespass upon the field implanted by physiological research with the warning sign of "dangerous."

The speaker claimed that the goal of illumination undoubtedly will have been attained when as a result of the concomitant development of its component illuminants it will be possible in every case presented to design a lighting installation which will be efficient, effective, artistic, which will produce an illumination correct in quantity and quality, properly balanced as to high lights and shadows, restful to the eye and harmonious with the form and numerous color schemes involved, which will stand the rigorous test of logical analysis and will appeal to the most highly developed sense of beauty.

### REPORTS OF COMMITTEES.

The committee on nomenclature and standards, of which Dr. Alexander C. Humphreys was chairman, did not submit a formal report, but referred to the work of the sub-committee on photometric units, a report from which was read by Dr. Clayton H. Sharp, the chairman. The report contained definitions of the various terms and units, such as light, flux, flux density, intensity, candle-power, lumen, lux, hefner-candle, foot-candle, lumen per square foot, lumen per square meter, etc. The committee strongly recommended the use of the term lumen per square foot rather than its equivalent the foot-candle. The lumen per square meter is the lux when the lumen is based on the international candle; when the hefner-candle is used the lumen per square meter becomes the hefner-lux. The committee recommended the use of the following symbols: $I$ for candle-power, $F$ for flux, $E$ for flux density, $Q$ for lumen hours, $e$ for angle of emission, $r$ for distance from light source, $\omega$ for solid angle.

In discussing the report of the committee Dr. E. B. Rosa suggested the report be considered as preliminary, action being deferred for one year so that other countries may be consulted as to preferences for symbols.

Dr. A. S. McAllister expressed the opinion that, unless very important reasons exist for doing so, selection should not be made of the sumbols $I$ and $E$, which are now the recognized symbols for current and e.m.f.

Mr. F. J. Pearson said that in formulating the photometric units and symbols recognition should be made of the c.g.s. units and other societies should be consulted. Mr. E. L. Elliott remarked that the symbol $J$ could be used for candle-power rathen than $I$, as is now done in Germany. Mr. H. T. Owens claimed that printed copies of the reports should be submitted to the members before any definite action is taken.

Dr. Sharp contended that no confusion will arise from the use of well-known electrical symbols for photometric quantities. He remarked that since the suggestions contained in the report were based on the terms used by Prof. Blondel the report would receive the endorsement of France and possibly England also. The suggestion of Dr. Rosa was then put in the form of a motion, which was carried.

The committee on the division of membership, of which Mr. E. L. Elliott was chairman, submitted a report suggesting that a division of membership be made at a time and in a manner to be determined by the full membership of the society. The report was discussed by Messrs. A. J. Marshall, H. T. Owens, F. J. Pearson, R. C. Ware, W. H. Gartley, G. H. Keech and C. H. Sharp. A motion to adopt the report having been lost, the committee was discharged, thereby placing the division of membership just where it was before the matter was agitated.

### ILLUMINATING ENGINEERING IN DENVER.

A paper entitled "Central Station Illuminating Engineering Department Work and Methods Applied by the Denver Gas & Electric Company," by Mr. C. F. Oehlman, was read by Mr. Williams. An abstract of this paper is given elsewhere in this issue.

Prof. S. W. Ashe described the education work being carried on by the General Electric Company at the Harrison (N. J.) lamp works. A lecture course in illuminating engineering and salesmanship is given to a corps of college men who are working upon the various processes of lamp manufacture. Certain men are trained in selling lamps by means of instruction in wiring and illumination, and certain men are selected for specialized subjects such as sign lighting, automobile lighting, street lighting, etc. An experimental lecture course is also given to the factory and office employees.

Mr. Norman Macbeth claimed that under present-day conditions it is essential for a lighting salesman to be trained along the lines of illuminating engineering. Mr. A. J. Marshall remarked that, since architects decide what lighting equipment will be used in most buildings, the Illuminating Engineering Society should attempt to co-operate with the architects rather than to antagonize them. In closing the discussion Mr. Williams said that the Denver company had found it advantageous always to supervise the installation of all pipes for gas and wires for electricity in order to ensure good results for the customers. He remarked that good illumination itself is the best advertiser in obtaining new customers.

### EFFECT OF LIGHT ON GERM LIFE.

In a highly entertaining lecture Prof. Samuel O. Mast described the effect of light on the movement of lower organisms. Strong light tends to destroy most germ life, but light of a lesser intensity may assist in building up complex out of simple organisms. These complex organisms serve as food for more highly complex organisms by stages until the more advanced organisms, such as small fishes, are reached; these serve as food for larger fishes, etc., so that even the well-developed organisms are dependent largely upon light. Professor Mast described in detail a certain simple form of germ, the movement of which in water is almost wholly dependent upon the density of light to which it is subjected, the germ adjusting its location so as to become parallel to the light rays and in a density of light best suited to its needs.

Dr. P. W. Cobb explained that the operation of the rods and cones in the eye is an example of the effect of light upon living members, quite similar to that on the lower organisms.

### ILLUMINATING ENGINEERING CHARTS.

Mr. J. S. Codman presented a paper describing two charts designated as the "angle" sheet and the "distance" sheet, respectively designed to serve as convenient means of recording the results of photometric tests, to facilitate the making of calculations from the test data recorded and to serve as a convenient record of such calculations so that repetition of work done will, to a great extent, be avoided. The charts are sheets showing the tangent, cosine squared, cosine cubed of the angles made with the vertical from 0 deg. to 180 deg., from which by easy steps can be calculated the average illumination over the floor area when the candle-power distribution of the lighting source is known.

The author outlined the advantages of the sheets and stated that they can be readily filled out piecemeal at convenient times, the work being taken up exactly where left off because all work previously done is permanently recorded. Since the sheets contain all the necessary constants they can be filled out with-

out reference to tables or books of any kind. At any stage of the proceedings additional copies of the data and calculations can be obtained by the simple process of blue-printing. He said that the sheets can be used to great advantage in calculations to ascertain what are ideal photometric curves for particular purposes. When definite flux or illumination values are required the corresponding candle-power values can readily be determined by working the sheets backward.

In discussing Mr. Codman's paper Mr. V. R. Lansingh called attention to a simple method for calculating illumination on the horizontal plane devised by Mr. . A. Wohlauer. According to this method the illumination at any point on the plane is found by dividing the indicated candle-power value projected on the vertical by the square of the height of suspension of the lamp.

STREET ILLUMINATION CONSIDERATION.

Mr. P. S. Millar presented a paper in which were outlined certain heretofore neglected considerations pertaining to street illumination. This paper is given in abstract elsewhere in this issue.

Mr. A. J. Sweet claimed that the effect of silhouetting in street lighting had been emphasized too much by Mr. Millar. The effect exists, but it is of relatively minor importance. While a non-symmetrical candle-power distribution was needed with the earlier types of street lighting equipments, the need is not so urgent to-day, when lamps of small candle-power are placed at close intervals to give uniform illumination. Of the highest importance is the elimination of glare, especially the specular glare from the street surface.

Mr. R. C. Ware remarked that when the lamps are widely spaced the intensity of illumination near the lamps is too high and the glare is objectionable. Dr. Sharp said that silhouetting lighting does not involve wide spacing of lamps, but requires merely a bright background formed by the street surface. One can easily solve the problem of lighting a street when no limit is placed on the number of lamps and the amount of watts. The problem becomes quite different when the money to be expended is limited.

Prof. S. W. Ashe stated that some tests made two years ago showed that with a lamp placed 8 deg. from the direct line of vision there was a decrease of 30 per cent in the ability to see, which value agrees closely with the results obtained by Mr. Millar. Mr. G. H. Stickney said that the use of non-symmetrical reflectors does not always give good results by reason of the difficulty in adjusting the reflectors.

On Monday evening a lecture of a popular nature intended for the benefit of the people of Baltimore was given by Mr. V. R. Lansingh. This lecture was followed by a reception and dance at the Hotel Belvedere.

## TUESDAY'S SESSION.

At the opening of the session of Tuesday morning the total registration was 218. Much enthusiasm was manifested over the announcement that the registration for the lecture course under the auspices of Johns Hopkins University and the society, which opens on Wednesday, was at that time no less than 212.

PERFORMANCE OF GAS LAMPS.

Many valuable data relating to the operation of gas lamps were given in a paper by Mr. Norman Macbeth entitled "The Relations Between Pressure and Light Output with Various Gas Lamps and Burners." The tests recorded show that reports on the light output and gas consumption of different lamps at different pressures may in no way be considered comparable unless the characteristic of the performance of each lamp is known at the various other pressures. To calculate the probable resultant illumination with any gas lamp it is also necessary not only to have this information, but also that pertaining to the average pressure of supply. There may be a variation in light production of from 100 per cent to 190 per cent depending upon whether the pressure is 1 in. or 8 in. and depending also upon the equipment used.

The paper by Mr. Macbeth was discussed by Messrs. Bassett Jones, Jr., S. W. Ashe, C. H. Sharp, H. T. Owens, J. H. Sherrerd, Preston S. Millar, W. E. Barrows, R. S. Hale and others. Mr. Macbeth stated that gas companies were formerly asleep and made little headway, while now they are wide-awake and making rapid progress.

HEAT FROM LIGHTING SOURCES.

Messrs. J. G. Felton and E. J. Brady, in a paper entitled "The Temperature Rise Due to the Energy Radiated in the Lower Hemisphere from Different Light Sources," reported the results of tests of the space distribution of light and heat flow in the lower hemisphere from various types of gas and electric lamps. The tests were made with a photometer and with a bolometer used in the same positions as the photometer. Of the electric lamps the carbon and the tantalum give off much more heat per candle-power than does the tungsten lamp. The ratio of the heat to the light in the lower hemisphere from the last-named lamp is greater when the lamp is provided with a prismatic reflector than when used without a reflector. Of the mantle gas lamps, the upright with opal dome and the inverted with a clear cylinder are about equal to the tungsten lamps, while all other gas lamps exhibit a much larger ratio of heat to light in the lower hemisphere.

The paper by Messrs. Felton and Brady was discussed by Drs. H. E. Ives and C. H. Sharp, Norman Macbeth and others.

COMPARISON OF PHOTOMETRIC METHODS.

The paper on the program by Dr. Herbert E. Ives was then presented and its discussion, owing to the approach of lunch hour, was deferred until the opening of the afternoon session.

In this paper, entitled "Some Spherical Luminosity Curves Obtained by Flicker and Equality-of-Brightness Photometers," Dr. Ives reported the results obtained by five observers in comparing the two photometric methods at two different illumination densities expressed in arbitrary values of 10 units and 250 units. Spectral luminosity curves obtained by the observers using the flicker and equality-of-brightness methods did not show exact agreement between the two methods. With different observers the relative positions of the two kinds of curves were different. At low illuminations the equality-of-brightness curves shifted toward the blue, the flicker toward the red. Marked differences in the color sensibility of the five observers exists, as shown by each method. The flicker method was found to possess much greater sensibility than the equality-of-brightness method, the difference being greatest at high illuminations.

The most important fact shown by the investigation is probably that the flicker method and the equality-of-brightness method give nearer the same values at high than at low illuminations. This result was thought probable before the investigation was undertaken, from consideration of the results of other observers. The author remarked that there is some reason for believing the flicker photometer to act chiefly by means of those elements of the retina called the cones in distinction from the rods. The cones are supposed to be responsible for vision at high illuminations, the rods at low. The Purkinje effect is ascribed to the shift from cone to rod action; it becomes very small at high illuminations. Furthermore, the flicker photometer had been found to show little or no Purkinje effect. It, therefore, seemed possible that at high illuminations, using a size of photometric field such that the retinal area used is very largely cone, the two methods might agree.

Dr. Ives' paper was discussed by Messrs. R. C. Ware, F. J. Pearson, George C. Keech and S. W. Ashe. Professor Ashe referred to his work in photometry at Columbia and also to the work of Mr. J. S. Dow on the flicker photometer. Dr. Ives claimed that the eye alone could be used as an instrument to compare candle-power, and that it is best not to compare lamps of different colors, but to refer each lamp to one of its color standardized at the laboratory.

At the afternoon session the remaining papers on the program, abstracts of which follow, were disposed of.

FLAME PHOTOMETRIC STANDARDS.

Messrs. E. B. Rosa and E. C. Crittenden reported the results of a study of flame photometric standards made at the Bureau of Standards. The authors found that, when proper account is taken of the humidity, temperature and barometric pressure, pentane lamps form a reliable source of standard candle-power. They found the same light-humidity coefficient for all ranges of humidity, namely, 0.0567 candle for a change in water-vapor of 1 liter per cubic meter. The light-barometric coefficient was about 0.6 per cent for a change of 1 cm in the pressure (mercury).

Three papers outlining the advantages of illuminating engineering to various interests were presented by Messrs. W. J. Serrill, J. F. Gilchrist and V. R. Lansingh.

Mr. Serrill stated that the commercial man is dependent upon the illuminating engineer for the design and development of the electric and gas lamps which he may offer to the public. In order to sell these he must have a comprehensive knowledge of the salient characteristics of each of the units. For this knowledge he is dependent upon the illuminating engineer. Since practical considerations force the application of lighting units to interiors into the hands of the canvasser, he must be able to solve problems relating to the illumination of interiors. The principles needed by the commercial man are relatively simple, and he can easily grasp them if he appreciates their importance and seriously applies himself to them. He should learn how to determine the amount of illumination from the curve of the lighting unit when the units are spaced at any given distance and height, and how to allow for the effects of reflection from walls and ceiling.

Mr. Gilchrist remarked that from the standpoint of their own interests the central stations should foster the development of illuminating engineering and the training of the young men in the industry to a thorough knowledge and appreciation of the fundamental principles of proper illumination. Proper influence should be exerted to ensure that the light produced will be used in the correct, hygienic and economical manner. That is to say, the education of the customer to an appreciation of proper illumination is of great benefit to the central station. Mr. Gilchrist contended that the central-station manager should wake up thoroughly to the fact that in the lighting end of his business what he should sell is an effective and useful illumination, and not merely electricity. He cannot sell the former without the aid of representatives who are thoroughly well educated and up to date in matters of illumination, and in such representatives he has nothing more or less than a corps of illuminating engineers, despite any prejudices he may entertain.

Mr. Lansigh classed the manufacturers who are benefited by illuminating engineering under the heads of makers of artificial illuminants, shades and reflectors, lighting auxiliaries and energy itself. The advantages to each of these were outlined. Mr. Lansingh said that by applying the laws of illuminating engineering the illuminant manufacturers' products are improved. A knowledge of illuminating engineering causes the salesman of a manufacturer to solicit business intelligently and obtain satisfied customers. Present-day shades and reflectors could not be produced without a comprehensive knowledge of illuminating engineering.

## Wisconsin Commission News.

The commission has handed down an order in the case of the City of Kaukauna vs. the Kaukauna Gas, Electric Light & Power Company, in which the petition of the plaintiff for an approved service has been granted. The petition alleged in the main that the commercial and private lighting service as furnished by the respondent lighting company was grossly inadequate. The evidence and the tests made by the engineers of the commission showed conclusively that the company's plant and distribution system are wholly inadequate to meet the reasonable demands of the city. The distribution system was poorly constructed in the first place and has never been properly maintained since. The power plant is in little better condition, for much of it is obsolete and there are many appliances lacking which are necessary to the rendering of good service.

The respondent attributes the poor condition of affairs to the failure of the City Council to sign certain street-lighting contracts extending over a period of years and calling for an increase in the number of street lamps. The contracts for some time past have been on the month-to-month basis and the company claimed that the uncertainty of the street-lighting business as now conducted did not warrant it in making the improvements necessary to give satisfactory service. And without certain of these needed improvements the commercial lighting service must remain unsatisfactory. Regarding this matter the commission says: "The rules prescribed by the commission concerning the standard of service required of every utility have not been observed, and could not in the situation be observed, until extensive work of repair, reconstruction and extension of the power plant and distribution systems was first performed. Further delay in putting the power plant and distribution system in an efficient operating condition will not be endured. The public is entitled to a reasonably adequate service. Neglect or failure to furnish such service is not excusable on the ground that the municipality refuses to enter into a contract with the company for street lighting."

Regarding the possibility of the city wishing to sign a contract for power at some future time and for an increased amount of power, the commission says: "The company cannot be expected to install units in its power house to meet unusual or exceptional demands. It must from time to time make such extensions to its system as public necessity requires, but it is not required to anticipate any unusual demands for service that may hereafter arise. Whenever any such exigency occurs it must be considered and provision made therefor, but any unnecessary enlargement of the plant to meet every possible demand for service is not justifiable, as it might result in placing an unjustifiable burden upon consumers by requiring them to pay returns upon additional investment as well as for the upkeep, depreciation and operation of property not reasonably necessary for their service." The commission suggests that if the city contemplates increasing the number of street lights it might avoid considerable delay if a contract were signed before the reconstruction, as ordered by the commission, was begun.

The commission has ordered that the respondent company make such additions, alterations and repairs as will render its power plant and distribution system adequate and efficient for the purpose of supplying the City of Kaukauna with reasonably adequate service and that it observe and comply with the standards of service as fixed by the commission. Ninety days is deemed a reasonable time within which to comply with the order and no postponement of the time of taking effect of the order will be granted.

The commission has authorized the Columbia County Electric Light & Power Company to issue $25,000 par value of twenty-year bonds, to bear interest at the rate of 6 per cent. The bonds are to be sold for money only and for not less than 75 per cent of the par value. Also 280 shares of common stock, of the par value of $25 each, to be sold for money only and for not less than par value.

The purposes for which the stock and bonds are to be issued and disposed of are as follows: (a) Bonds of the par value of $18,000 and stock of the par value of $6,950 are to be issued and exchanged for the interest and property of what is now known as the Duck Creek Light & Power Company; (b) stock of the par value of $50 and bonds of the par value of $7,000 shall be issued and sold for the purpose of supplying the company with funds for making additions and extensions to the property.

## Maryland Commission News.

The Public Service Commission will begin the latter part of this week hearings on the schedules of rates proposed by the Chesapeake & Potomac Telephone Company as a substitute for the schedule of charges now made by it. Since the matter was first brought up the commission has been gathering data and information from every available quarter in order that it might feel competent to deal with the question when it was brought up. Although the new schedules were filed in the summer, the representatives of the company requested a postponement of the hearing because of the absence of some of its officials. Oct. 24 was fixed by the commission as the time for the first hearing, but it is likely that the real hearings will not be begun until a few days later, awaiting the return of all of the counsel and parties interested from their vacations. While the new rates are proposed as reductions, the flat rate for unlimited service has been eliminated. This feature of the proposed schedules has created dissatisfaction and led to protests being filed with the commission.

The subject of lower rates for gas and electric service asked for by the City of Baltimore will come before the commission in formal complaints which Mayor Mahool and the City Solicitor will file within the next two weeks. During the summer months experts employed by the city have been preparing the city's side of the case. Superintendent Robert J. McCuen, of the Department of Lamps and Lighting, recently reported to the Mayor conclusions which he has reached through the aid of electrical experts as to the cost of electricity for street lighting and service to municipal buildings. Prof. Charles E. Munroe, of the George Washington University, a gas expert, will complete within the next week his report regarding the rates charged in Baltimore for gas. While both the reports of Mr. McCuen and Professor Munroe deal particularly with the rates charged to the city for gas and electricity, yet it is expected that they will be made the basis of a demand by the city for a reduction in general commercial rates.

## New York Commission News.

The Public Service Commission, Second District, has made order requiring the New York Telephone Company to file on or before Nov. 1 a schedule showing the number of pay stations operated within the City of New York, together with the gross earnings received therefrom. It is required that the statement show separately by the districts as adopted by the company and by classification as shown in its schedule of tariffs filed with the commission: the number of pay stations, automatic pay stations and approximate number of each type of automatic pay stations in use in each district; the different classes of locations in which pay stations are now established, together with the relative number in each class, and whether standard pay stations or automatic pay stations.

The commission has also required every telephone corporation under its jurisdiction to file on or before Nov. 15 schedules which will show by each exchange separately those of its patrons or subscribers who are receiving telephone service of any character at rates or charges which vary or differ in any respect from the standard rates adopted and now in force for contracting new business.

The commission has also ordered every telephone corporation under its jurisdiction to file on or before Dec. 1 schedule showing all rates, rentals and charges for services of each and every kind by or over its line or lines between points in New York and between each point upon its line and all points upon every line leased or operated by it and all points upon the line of any other telephone corporation whenever a through service or joint rate shall have been established between any two points.

Such schedules are required to show also all charges and all privileges or facilities granted or allowed and any rules or regulations or forms of contract which may in any wise change, affect or determine any or the aggregate of the rates, rentals or charges for the service rendered.

The commission has received a complaint from Academy Grange No. 62, of Cheshire, Ontario County, directed against the Interlake Telephone Company increasing its rate from $12 to $15 per year. Complaint is also made of the service now rendered the public. Complaint has been served upon the company and an answer required within twenty days.

The commission will give a hearing this week on the application of the Suffolk Gas & Electric Light Company for authority to acquire all of the outstanding capital stock of the East Islip Electric Company and to merge that company; on the complaint of the East Islip Light Company against the Sayville Electric Company alleging that the latter company is unlawfully stringing wires and furnishing electricity at East Islip; on the application of the Islip Light Company for authority to issue $30,000 of common capital stock and $20,000 of bonds; on the application of the Hudson River & Eastern Traction Company, of Ossining, for authority to issue $50,000 additional common capital stock and $850,000 additional first mortgage bonds; on the complaint of the Middleport Gas & Electric Light Company against the A. L. Swett Electric Light & Power Company alleging unlawful operation in construction of lines in the town of Royalton, Niagara County; and on the application of the Middleport Gas & Electric Company for permission to exercise franchises in the town of Royalton.

The commission has authorized Mr. Moritz Mayer, of Syracuse, to transfer and assign the franchises granted by the village of Camillus and town of Camillus to furnish electricity to those communities to the Syracuse Lighting Company, the latter named company to carry out the provisions of the franchises, the municipalities having consented to such transfer. An agreement has been approved of whereby the Hornellsville Electric Railway Company, Hornellsville & Canisteo Railway Company and Canisteo Valley Electric Railway Company are consolidated into one company known as the Hornell Traction Company. The new company is authorized to issue common capital stock to the amount of $120,000, which shall be exchanged for the stock of the consolidated companies.

## Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has received a petition from the Plymouth Electric Light Company asking the approval of the board upon a proposed issue of $30,000 worth of additional capital stock, the proceeds of which are to be used in paying off funded debt incurred in making extensions to the company's physical plant. A hearing will be assigned.

The Massachusetts Railroad Commission gave a hearing on Oct. 18 upon the petition of the Selectmen of Abington for the establishment of a 5-cent fare from all parts of the town of Abington to the City of Brockton, on the lines of the Old Colony Street Railway Company. Bentley W. Warren, Esq., Boston, appeared for the company and stated that if the fare should be granted it would be a financial injury to the lines in question and would cause discrimination between Whitman and Abington as regards service between those towns and Brockton. He argued that the present fare affords a rate of only 1 cent per passenger mile, which is too low for profitable operation in New England country districts. The board took the case under advisement.

The board heard the petition of the Mayor and Aldermen of Newburyport on Oct. 19, praying for fare reductions and extensions of transfer privileges on the lines of the Haverhill & Amesbury Citizens' Electric and Boston & Northern Street Railways Companies. City Solicitor Withington, of Newburyport, represented the petitioners, who urged that the board require the three companies to interchange transfers in Newburyport so that a uniform 5-cent fare would prevail in the city, and to reduce the fare from Newburyport to Smithtown, at the New Hampshire state line, from 10 cents to 5 cents. President David A. Belden, of the Haverhill & Amesbury company, submitted figures showing that in the past ten years the company has accumulated a deficit of about $110,000. The com-

pany is a part of the system controlled by the New Hampshire Electric Railways, but Chairman Hall refused to recognize the holding organization, although pressed to do so by the petitioners. He declared in no uncertain tones that the business of the Massachusetts board is with the equity of fares and the financial showing of Massachusetts street railways, rather than with outside corporations with which they may be affiliated. The petitioners endeavored to show that the original franchise granted the Haverhill & Amesbury company called for a 5-cent fare between Smithtown and Newburyport, and contended that the agreement was at least morally binding, although, as Chairman Hall pointed out, the decision of the Massachusetts Supreme Court in the case of Keefe vs. Lexington & Boston Street Railway Company, decided in 1904, stated that a conditional franchise is not legally binding. Chairman Hall asked the petitioners four times if they would declare that such an agreement is morally binding if it can be shown that it is financially impossible, and each time the reply was an evasion. The board closed the hearing and took the case under advisement.

At recent hearings upon Boston transit matters before the joint board consisting of the Massachusetts Railroad and Boston Transit Commissions a strong sentiment has been displayed in favor of relocating the new subway shortly to be built under the Charles River embankment from Park Street to the Charlesgate district. An association of influential merchants in the Back Bay proposes the construction of a four-track subway under Boylston Street and Commonwealth Avenue, with provision for local car service under Washington and Essex Streets to the South Station. A plan has been advanced for the establishment of express service to Park Street by a subway loop from Church Street running under Boston Common, with a station at Church Street for inter-train transferring. It is contended that the completion of the river-bank subway will tend to drive shopping away from the Back Bay, since it will deflect from that district a large part of the traffic which now passes through it by surface cars serving the western suburbs of Boston. Another project to which the joint board has given attention is the proposed West End loop in connection with the Boston terminus of the Cambridge subway. Property owners in the West End emphasize the fact that the district is rapidly deteriorating and that it needs new rapid transit facilities in order to attain a commercial and moral revival. A hearing will be given in the near future at which the Boston Elevated Railway Company will present its views regarding changes in the subway plans now authorized by law. It is probable that the company will adhere, in large measure, to the existing plans, which have been laid out with the transportation welfare of the metropolitan district as a whole in mind. The estimated cost of building a four-track subway under Boylston Street is at least $7,000,000, and it is questionable if the company, committed as it is to huge expenditures for rapid-transit improvements under present construction, would consent to further responsibilities of the kind outlined above. An interesting phase of the situation is the publication in the Boston dailies by the Boston Elevated Railway Company of a series of maps showing the part the company has had in developing rapid transit in the past decade.

A hearing was recently given by Governor Draper at Boston upon the complaint of a committee of subscribers of the New England Telephone & Telegraph Company that the new rate schedule proposed by the Massachusetts Highway Commission will result in larger telephone bills than prevail under the present system. Evidence was introduced by Representative C. A. Dean, of Wakefield; Mr. Benjamin C. Lane, of the United Improvement Association; Mr. William E. McClintock, chairman of the Chelsea Board of Control, and others. Governor Draper pointed out that the authority of the Highway Commission over telephone rates is derived from the Legislature and that his own power is only appointive. He stated that the object of the commission was to reduce telephone rates, after it had gone thoroughly into the matter, and that the actual working out of the problem is most difficult, since many persons have been receiving service at less than its fair cost. The Governor pointed out that State regulation presupposes equality to all as nearly as can be attained. Concluding, he said that he would do everything he could to see that the committee had full opportunity to be heard. Commissioner William D. Sohier then stated that if the committee would ask for a hearing on the new rates the Highway Commission would be glad to give one, and he pointed out that in spite of all the agitation which had arisen the board had not been asked to give such a hearing.

The joint commission on metropolitan improvements, composed of the Massachusetts Railroad, Harbor and Land, Metropolitan Park and Boston Transit Commissions, gave a public hearing at Boston on Oct. 20 upon the proposed tunnel between the North and South Stations. The hearing was given over to arguments in oposition to the tunnel, and among the speakers were Mr. William B. Lawrence, of Medford, Mass.; Mr. Joseph B. Eastman, Boston, secretary of the Public Franchise League; Mr. Charles A. Ufford and Mr. J. W. Ayres, Boston. It was argued that the estimated cost of such a tunnel, equipped for electrical operation, is too great an investment for the results contemplated. The estimate is $16,000,000. Secretary Eastman favored the construction of the tunnel by the Boston Transit Commission, by the railroads, with immediate State ownership, and, as a third alternative, construction and ownership by the Boston Terminal Company, which built and owns the South Station. Chief Engineer Wheeler, of the New York, New Haven & Hartford Railroad Company, stated that the plans for the tunnel had been presented to a sub-committee of the joint board and that the company considered no further statement necessary at present.

## CURRENT NEWS AND NOTES.

**I. E. S. Lecture Course.**—The number of registrations for the lecture course at Johns Hopkins University under the joint auspices of the university and the Illuminating Engineering Society had reached 212 on Tuesday morning of this week.

**Next Joint Electrical Meeting in Chicago.**—The next joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former in the Monadnock Building, Chicago, on the evening of Wednesday, Nov. 23. Dr. E. J. Berg, professor of electrical engineering in the University of Illinois, will address the meeting on "The Surging of Synchronous Machines."

**Electrical Workers' Union on the Isthmus.**—A meeting was called for Oct. 9, at Ancon, on the Isthmus of Panama, for the purpose of installing a local lodge of the International Brotherhood of Electrical Workers. This lodge was to have jurisdiction over the Canal Zone. It is probable that by this time the union is in regular working form. The notice for the meeting said that all electrical workers were eligible to become charter members, and it is interesting to observe that this notice was published in the official organ of the Isthmian Canal Commission.

**"The Big Stick."**—On the occasion of the visit of Theodore Roosevelt to Milwaukee last month the Milwaukee Press Club celebrated the occasion by issuing the first, last and only number of *The Big Stick*, a twelve-page, seven-column newspaper published solely in honor of the former president. The paper had many interesting articles, and, with its editorials, illustrations, cartoons, fashion hints, theatrical, market, marine and sporting departments, all cleverly relating in some way to the distinguished guest, was really a notable production. Advertising was carried, and the paper bore every mark of a modern, enterprising and prosperous daily. Electrical men will feel an especial interest in the achievement from the fact that the idea was suggested and its execution actively assisted

by Mr. Charles L. Benjamin, advertising manager of the Cutler-Hammer Manufacturing Company.

**Large Attendance at New York Electrical Show.**—Although the actual figures are not yet available, those in charge of the New York Electrical Show state that the attendance during the ten days of the show was, in round numbers, 160,000.

**The Dangers of Gas.**—One of the large gas interests has taken the precaution to supply its plant with a kit for use in case of asphyxiation. This consists of a handled box containing, among other things, effervescing phosphate of ammonia and aromatic spirits of ammonia, with sponge attachment, wooden tongue pliers and wooden jaw blocks. This should make an instructive exhibit for a central-station showroom.

**St. Lawrence Power Transmission Company.**—Another effort is being made by the St. Lawrence Power Company to obtain the consent of the Dominion government to the development by the company of the Long Sault rapids. A further set of plans was submitted to the government's engineers at Ottawa on Oct. 19, but no conclusion was reached. Mr. F. W. Bowden, chief engineer of the Department of Railways and Canals, will make a tour of inspection of the proposed works.

**Meeting of New York Electrical Society.**—At the next meeting of the New York Electrical Society, to be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Oct. 28, Mr. Gilbert H. Aymar will lecture on animated photography in natural colors. The lecturer will outline briefly the principles of the art of motion photography and also describe the various steps taken in the development of "kinemacolor," a process by which the actual colors of the objects photographed are reproduced.

**A Central Station "Opening" in St. Louis.**—On the occasion of the opening of its new West End branch office at 4912 Delmar Avenue, near Euclid Avenue, on Oct. 19 and 20, the Union Electric Light & Power Company, of St. Louis, gave away a number of electric household appliances. These gifts included such conveniences as electric toasters, flatirons, corn poppers, coffee percolators, chafing dishes, waffle irons, curling irons, shaving mugs, etc. The opening was advertised in the daily newspapers and attracted much attention.

**Fort Wayne A. I. E. E. Section Excursion.**—Twenty-six members of the Fort Wayne (Ind.) section of the American Institute of Electrical Engineers of Fort Wayne made an inspection trip last week in a special car over the Fort Wayne & Wabash Valley Traction line. The start was made from the Fort Wayne Electric Works, and the first stop was at Delphi to inspect the modern substation of the road at that point. The party then proceeded to Lafayette, arriving at 1 o'clock. After dinner they inspected the company's new power house, leaving on the return trip at 6 o'clock.

**Denver Electrical Show.**—The Colorado Electric Club at its weekly lunch, on Oct. 20, held an informal report meeting to discuss the popular and financial results of the Denver Electrical Show. About 50,000 paid admissions were recorded, and opinion on all sides was favorable to the continuance of annual shows. One hundred per cent dividends and a balance in the neighborhood of $2,500 were also announced. Plans for entertaining the Jovians at next year's annual rejuvenation in Denver will be discussed by the club at a business meeting and smoker Saturday evening, Oct. 29.

**Utilization of Dam of Unknown Origin.**—Situated in the Animas Valley in New Mexico and extending across the boundary line into Mexico are the remains of a dam 15 miles in length. This dam, which was constructed by people of an unknown civilization, is of semicircular shape, 40 ft. high, 150 ft. wide across its base and 40 ft. wide at the top. It was built of earth mixed with concrete material, and is in an excellent state of preservation. It is reported that the 100-ft. break in the dam will probably be repaired and an enormous reservoir will thus be formed for irrigation and other projects.

**Columbia University School of Industrial Arts.**—The Teachers' College of Columbia University, New York, has established a School of Industrial Arts, devoted to the technique of fundamental processes in industries and commerce and the study and practice of the educational method of these subjects in the work of instruction in schools of various types and grades. Instruction will also be given in evening technical courses to all qualified students who desire to obtain technical knowledge in trades and professions represented by the courses. Mr. Victor R. Greiff is in charge of the instruction in electricity, which includes a course for wiremen, linemen, dynamo attendants and others working on or handling electrical apparatus, and an advanced course in electrical machinery.

**Letters for Four-Party Telephone Calls.**—Letters of the alphabet, in addition to numbers, are being used in calling telephone subscribers on four-party lines in the suburban district around Chicago. The letters chosen, after much experimenting to select those best adapted for telephone enunciation, are L, R, J and W. No letters are used in connection with numbers except on the four-party line service. But a subscriber on a four-party line will have a letter added to his present number, as, for instance, 786-R. It is believed that the addition of letters will decrease the likelihood of making mistakes. The introduction of this system is not contemplated in the City of Chicago, but the plan has been carried into effect in Joliet and other near-by places within the territory of the Chicago Telephone Company. The combination of numbers and letters for telephone calls is not new, but it is something of a novelty in Chicago and its vicinity.

**Meeting of Cleveland A. I. E. E. Section.**—Lamps and illumination were the theme of the program for the regular October meeting of the Cleveland Section of the American Institute of Electrical Engineers, which was held Monday evening, Oct. 17, in the rooms of the Cleveland Engineering Society, 718 Caxton Building. Mr. G. S. Merrill reviewed his paper on "Tungsten-Filament Lamps," which he presented before the Toronto Section and which appeared in the September *Transactions* of the A. I. E. E. Mr. M. D. Cooper discussed the stresses which exist in filaments when lamps are burned in a horizontal position and also described the methods of deriving equations for accurately calculating the performance of various types of filaments. Mr. J. G. Henninger gave a brief résumé showing that there is almost no field of illumination which has not felt the effect of the new high-efficiency lamps. The importance of providing proper light in industrial work was touched upon by Mr. Ward Harrison. The insignificant cost of such lighting when compared with the value of the workman's time, said Mr. Harrison, is quite striking. Assuming on an average a wage of 30 cents an hour by the use of high-efficiency lamps, the saving of twenty-four seconds of the workman's time each day, by reason of the better illumination, would pay the entire cost of his share of illumination for two hours. As it is probable that much more time than this would be saved each day, a good rate of return is, therefore, secured upon the money invested in proper lighting. The proper method of calculating comparative costs of lighting was also discussed by Mr. Harrison, and the necessity of considering the items of depreciation and maintenance and the efficiency of utilization was particularly emphasized. Calculations on this basis show that the present cost of producing the electric light is less than the cost of equivalent lighting with gas, exactly the reverse of the opinion accepted by many.

Mr. J. D. Hoit presented a number of excellent views of industrial illumination with incandescent lamps in various classes of service from steel and textile mills to breakfast-food factories. At the conclusion of this paper a general discussion on the several papers took place.

## ELECTRICAL EQUIPMENT OF THE PLYMOUTH ELECTRIC LIGHT COMPANY.

ELECTRICAL service in the historic town of Plymouth, Mass., is supplied to the community by the Plymouth Electric Light Company, whose generating plant is located on Leyden Street, the oldest thoroughfare in New England. Central-station distributing circuits to-day occupy a field which less than 300 years ago was often darkened by Indian arrows aimed in vain against advancing civilization. The historic charm of this typical New England seaside community outlasts repeated visits; but its industrial life is so diversified that there is nothing incongruous in the maintenance there of a progressive central-station organization, although in the central shrine of American liberty. The sense of past glories is so keen, however, in Plymouth that one cannot help speculating upon the amazement which even valiant Captain

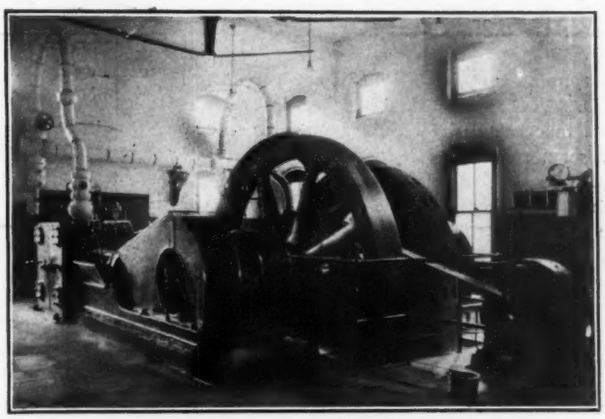


Fig. 1—360-kw Unit Engine Room.

Standish and his devoted followers would display if permitted to witness the transformation of their ancient street which has been effected by the establishment upon it of the most modern electric generating facilities.

The Plymouth company serves 709 customers in the three Massachusetts Bay towns of Plymouth, Duxbury and Kingston. Its outstanding capitalization on June 30, 1910, was 900 shares of stock of the par value of $90,000. The local industries include the largest cordage factory in the world, woolen, tack and rivet mills, zinc works, foundries and laundries. The population of Plymouth is about 12,000 and the total population tributary to the local central-station service is approximately 15,000. In the past three years the connected motor load has risen from 487 hp to 985 hp; an excellent day load in proportion to the size of the district served has been established; the tungsten lamp has come into general service for street lighting; gross earnings have increased from $36,848 to $50,809, and the total investment in the plant has increased from $174,313 to $222,221.

The generating plant of the company was crippled by a serious fire on April 26, 1909. The equipment of the old station consisted mainly of a 250-hp McIntosh & Seymour engine belted to a 150-kw, three-phase alternator, two multipolar, 90-kw 550-volt, direct-current generators; a 200-hp Ide engine belted to a 120-kw, single-phase alternator and a 90-kw, direct-current generator; a 125-hp Ide engine belted to a 90-kw, single-phase alternator, and a 360-kw, direct-connected alternator driven by a Harris-Corliss horizontal cross-compound engine. The last unit had just been installed when the fire broke out. As soon as the fire occurred General Manager E. P. Rowell made arrangements with the Brockton & Plymouth Street Railway Company for the supply of energy temporarily from its generating plant. A 200-kw, three-phase generator was shipped on a rush order from the Schenectady works of the General Electric Company and belted to an engine in the Brockton & Plymouth station. The entire service of the Plymouth Electric Light Company was restored within fifty hours of the fire, temporary overhead circuits being run to the street railway plant from the Leyden Street station, a distance of about half a mile. The company did not lose a single customer by the fire.

It was immediately decided to rebuild the Leyden Street station along thoroughly modern lines. The 360-kw alternator was found to be capable of service after a complete drying out and a second unit of the same size and type was purchased, both being installed in a 70-ft. x 33-ft. engine room. Each unit consists of a 15-in. x 28-in. x 30-in. Harris-Corliss engine driving a 360-kw, 2300-volt, three-phase, 60-cycle General Electric revolving-field alternator. The station building is a brick structure with an expanded metal roof supported by mill construction. Fig. 1 shows one of the 360-kw units, with its piping, and the general character of the roof construction. Each unit is provided with an 18-kw, 125-volt exciter, belt-driven from the flywheel shaft. The two units are installed with their axes at right angles on account of the limitations of space in the engine room. The normal speed of each unit is 150 r.p.m. The plant is provided with a ten-panel marble switchboard located on the floor of the engine room, shown in Fig. 2. There are one exciter, two machine, two reserve, four feeder and one street-lighting panel, with the usual synchronizing bracket, lamps and indicator. The street-lighting panel carries three circuits, only two of which are as yet in use. Two sets of busbars are provided on the 2300-volt service and duplicate switches of the oil-break type, so that either generating unit can be thrown upon either busbar. The same arrangement applies to the feeder circuits, one switch being provided for one busbar and a second for the other. The feeder is tapped off a common terminal connection of each switch and this arrangement saves space upon the back of the board. Two 125-volt exciter busbars are provided at the rear of the board.

Each generating unit is supplied with live steam from two batteries of three boilers located in a fire room adjoining the engine room. There is one horizontal return-tubular Strothers & Wells 150-hp boiler in the plant and there are two

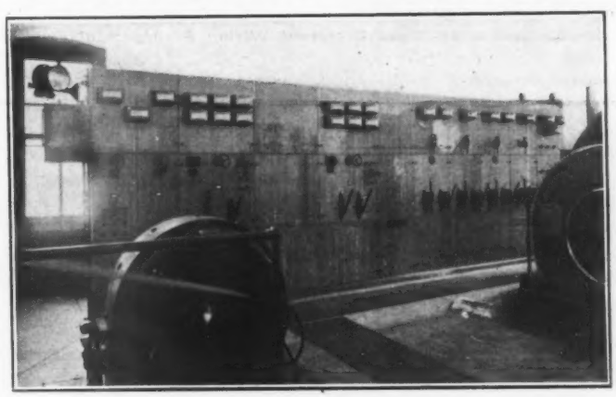


Fig. 2—Switchboard.

Babcock & Wilcox water-tube boilers rated at 200 hp each, the normal steam pressure of the service being 140 lb. The engines are equipped with a gravity-feed oiling system with an elevated tank in the engine room to which the oil is pumped after being stored and filtered. Each engine is of the condensing type, fresh water for boiler feeding being supplied from the old Town Brook. The plant is located practically on tidewater. The piping is so arranged that if the high-pressure cylinder of either unit fails steam can be supplied to the low-pressure cylinder through the receiver and a reducing valve, enabling the engine to be operated at reduced load on the low-pressure cylinder. Provision is also made for exhausting into either the condenser or the atmosphere, an automatic valve being provided in the exhaust piping so that if the vacuum becomes broken the engines will discharge steam into the air at the top of the station building. Worthington jet condenser

equipment is installed. The live-steam supply from the boiler room is drawn from an 8-in. main, the engine high-pressure cylinders being served by 5-in. branches.

On account of the limited space in the engine room one belt-driven exciter is installed in the basement below, as shown in Fig. 3. This photograph also shows the arrangement of the outgoing feeders and the series transformers under the switchboard floor level, with the wall opening whence the outgoing lines pass to the street and thence diverge to the

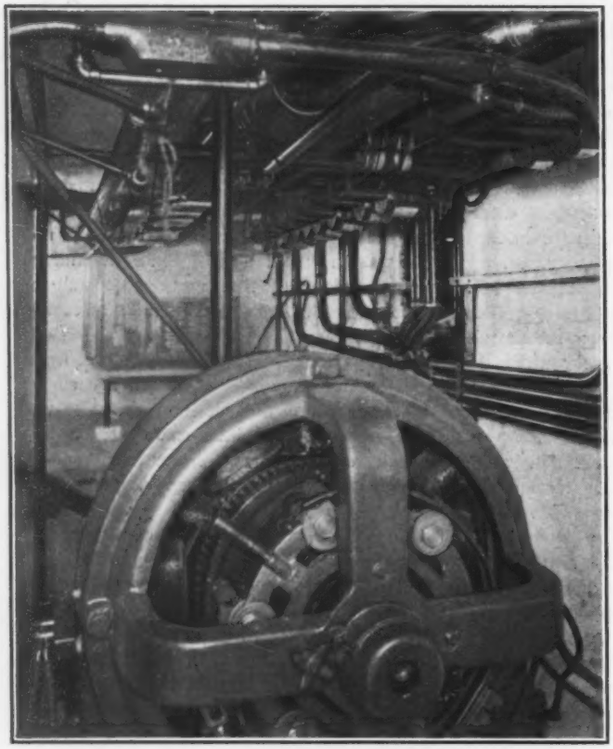


Fig. 3—Engine-Room Basement Wiring Arrangements.

various centers of distribution. The field rheostats are also carried on a concrete framing in the engine-room basement The station wiring is carried in conduit throughout. The con duits are in general carried on 1.5-in. pipe racks.

Adjoining the engine room is a motor-generator room 40 ft. x 30 ft. in dimensions. This at present contains a 150-kw, 550-volt, direct-current multipolar generator belt driven by a 200-hp, three-phase General Electric synchronous motor and a 15-kw direct-current generator driven by a belt attached to a 20-hp synchronous motor. A four-panel switchboard is used in measuring and controlling the output of these machines, which in the main supply energy to the company's direct-current system. The motor-generator room is large enough for the installation of a steam turbo unit in case it becomes desirable later. The smaller of the two present sets is used to carry the minimum load late at night or on Sundays and holidays. Fig. 4 shows the motor-generator room and Fig. 5 shows the company's load curve on the day of the maximum peak during the past year. The maximum load attained was 300 kw and the average load throughout the daylight period was about 250 kw. The day's output was 4530 kw-hours.

The company's prices for motor service vary from 10 to 3 cents per kw-hour with discounts of 0 per cent to 70 per cent, according to consumption. A minimum charge of $1 per horse-power per month is made for motors rated between ⅛ hp and 5 hp if not used. The liberal discounts given for large consumptions have been responsible for much of the company's recent success in securing a larger connected motor load.

The lighting rates are divided into two classes, "A" and "B." "A" customers are defined by the company as those who have a large number of lamps installed and use only a few of them, or customers who do not use lighting every night of the week, such as house and store lighting, particularly where the store is closed the majority of nights each week. "B" customers are those who use practically all their lights every night, such as drug stores, restaurants and hotels. In the past it was the custom of the company to allow discounts ranging from 5 per cent to 35 per cent for "A" customers and 10 per cent to 50 per cent for "B" customers. This kind of a rate was found to be inequitable, as there were conditions under which it would have been cheaper for the customer to have used a little more energy. For example, if a customer's bill was $9.90, his bill after a 5 per cent discount would have been $9.41. If, however, he had used $10 worth of energy, he would get a discount under the old plan of 10 per cent, making the bill $9.00 net. In other words, 50 kw-hours were cheaper by 41 cents than 49.5 kw-hours were.

To overcome this difficulty the company arranged a sliding scale, with rates of 18 cents, 13 cents, 11 cents and 10 cents per kw-hour, as follows: For energy used up to 100 kw-hours, 18 cents; for the next 100 kw-hours, 13 cents; for the next 100 kw-hours, 11 cents; for all additional energy, 10 cents.

A minimum charge of $1 net per month is made on all bills. The results of this schedule are: First, an equitable rate to customers; second, a uniform discount for all classes of service; third a reduction in rate of 20 per cent to customers whose bills are less than $5 and a substantial reduction to large users. This rate means a saving of 38 cents net on a bill for 10 kw-hours, 76 cents on 20 kw-hours, $1.12 on 40 kw-hours, $1.26 on 70 kw-hours and 80 cents on 100 kw-hours. A discount of 10 per cent is allowed on bills of "A" customers and 20 per cent on bills of "B" customers. The company's lighting service is a single-phase, 60-cycle, 110-volt alternating supply.

The street-lighting service is given by means of two tub transformers of 6.5 amp rating and 32.5-kw combined rating. There are now eight municipal arc lamps and 365 50-watt tungsten incandescent lamps in street service. During the past year the street lamps were burned 3039 hours. The arc lamps are run upon an all-night moonlight schedule at a rate of $125 per lamp-year and service on a midnight moonlight schedule is charged $85 per lamp-year. The incandescent rates run

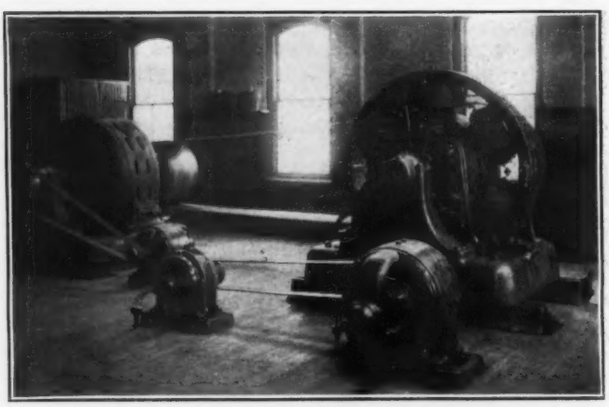


Fig. 4—Motor-Generator Room.

from $20 to $21 per year. The company's connected load in kilowatts is as follows: Municipal arc lamps, 3.6 kw; commercial arc lamps, 3.6 kw; municipal incandescent lamps, 18.2 kw; commercial incandescent lamps, 906.5 kw; Nernst lamps, 8.9 kw; alternating-current motors, 485.0 kw; direct-current motors, 229.0 kw. The total is 1654.8 kw.

The company's system now includes 152 transformers, the most common size being 600 watts, thirty-eight of these being in service. There are 779 meters and the company has 1500 wooden poles and 751,228 ft. of wire in operation. The distribution circuits include 10,576 ft. of arc-lamp circuits, 182,720 ft. of municipal incandescent lamp lines, 329,540 ft. of primary alternating-current wire, 171,192 ft. of alternating-current secondary wire,

46,500 ft. of direct-current motor-service lines and 10,700 ft. of alternating-current motor-service primary lines. A 24-hour service is furnished by the company. It does not wire buildings. The output for the year ended June 30, 1910, was as follows: Total kw-hours at switchboard, 1,134,201; kw-hours for street lighting, 67,560; kw-hours for commercial lighting, 301,768; kw-hours for motor service, 361,142; total accounted for, including 10,500 kw-hours used by company, 740,970; total kw-hours unaccounted for, 393,231.

The company's revenue for the year was $50,808.85, the larger items being commercial lighting, $27,534.71, and electric motor service, $15,118.18. The average revenue per kw-hour sold was 7.65 cents and the average income per kw-hour sold for motor service was 4.16 cents. The income from all

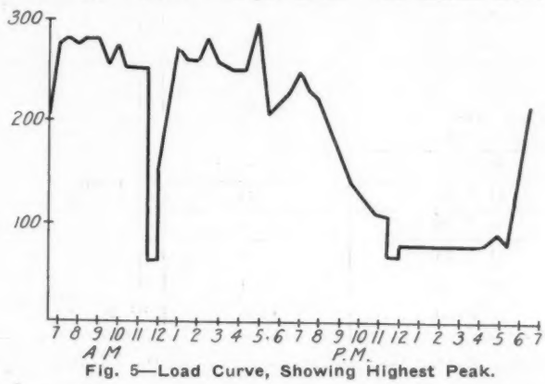



Fig. 5—Load Curve, Showing Highest Peak.

sales per kilowatt of station rating was $59.30. The company's investment on June 30, 1910, was as follows: Lands, $3,964.50; buildings, $18,421.23; steam plant, $57,914.68; electric plant, $63,055.10; overhead lines, $54,912.56; Nernst lamps, $940.69; transformers, $8,527.61; meters, $12,245.33; arc lamps, $2,238.98; total, $222,220.68, or approximately $255 per kilowatt of station equipment.

The net station cost of electrical production at the switchboard for 1910, exclusive of any fixed distribution or administrative charges, was about $11,190, or 1.72 cents per kw-hour manufactured. The company burned 251 tons of Cumberland coal and 766 tons of New River coal during the year, the former costing $4.03 and the latter $3.96 per ton. The total operating expenses were $35,829, or 3.16 cents per kw-hour. The company purchased about 484,000 kw-hours from the local street railway company at an approximate cost of $8,497.

The officers of the company are: President, Arthur C. Bent, Taunton, Mass.; clerk, Arthur Lord, Plymouth, Mass.; treasurer and manager E. P. Rowell, Plymouth, Mass.

## NIGHT-SCHOOL SCHOLARSHIPS IN CHICAGO.

President Samuel Insull, of the Commonwealth Edison Company, of Chicago, has issued a letter to the employees of the company in which he says that the results obtained by the award of night-school scholarships last year by that company are so encouraging that the company has decided to award scholarships for additional courses this year to such of last year's students as are worthy of further encouragement in the judgment of the employees' committee. In addition, the company will also issue thirty-two night-school scholarships to worthy employees, which will cover tuition for one course in one school-year at a cost not to exceed $15 in some night school within the city of Chicago. The employee receiving such a scholarship will, subject to the approval of the employees' committee, be allowed to select both the school and the course, but the studies in this course must be such that they will benefit the employee in his work for the company. The conditions under which such scholarships will be awarded are: (a) At least one year's service with good record. (b) Sufficiently good health to undertake night-school work. (c) Studious habits. (d) An observing disposition. Applicants for the scholarship must make their requests through the heads of their departments or subdepartments.

## A STUDY OF SLEET LOADS AND WIND VELOCITIES.

By FRANK F. FOWLE.

The engineer who is called upon to design pole lines or transmission lines is frequently beset with the difficulty of obtaining reliable data on sleet and wind loads. Sleet storms occur nearly every year throughout large areas of this and other countries. Occasionally they are so severe as to prostrate many lines, especially those of the lighter types of construction, causing much financial loss and interruption to service. The majority of sleet storms occur with some wind, and the combination of wind with sleet, or with wet adhesive snow, is usually the condition which creates the severest loads. An investigation of the stresses which result from this combination reveals the fact that it is most essential to know how much sleet and how much wind will occur simultaneously in given localities. It is impossible, of course, to formulate any general rule or statement in this regard for a country so large as ours, because the climatic conditions range between wide extremes.

The most reliable data now obtainable for the country as a whole are to be found in the records of the United States Weather Bureau. The observatories are so numerous and the observations are now so comprehensive that valuable information can be obtained for practically every locality. The present article deals with an analysis of the Weather Bureau records at Chicago, Ill., made through the courtesy of Mr. Henry J. Cox, in charge of the station. The observations of the Weather Bureau have been amplified from time to time, and while now comprehensive, they were formerly not so much so. It was not possible, therefore, to extend certain portions of the analysis over very long periods, such as twenty years or more. However, the data obtained are believed to furnish the means of drawing valuable conclusions.

Before taking up the analysis in detail the history of the Chicago station will be given, briefly, for the period covered by the study. On June 8, 1873, the station was moved from a former location to the southeast corner of Madison and La Salle Streets, on the Major block, at an altitude of 103 ft. above the street. It remained here until Jan. 1, 1887, and was then moved to the southwest corner of Clark and Washington Streets, on the Chicago Opera House block, at an altitude of 153 ft. above the street. In February, 1890, it was moved to the southwest corner of Wabash Avenue and Congress Street, on the Auditorium, at an altitude of 274 ft. On June 10, 1905, it was moved to its present location on the Federal Building, bounded by Jackson Boulevard, Dearborn, Adams and Clark Streets, at an altitude of 310 ft. above the street. The altitude of the station has increased progressively since 1873, the change in 1890 being very marked.

On account of these changes in altitude it was necessary to divide the study into corresponding periods. The effect of altitude on velocity is very important, although it is only one of several factors that need to be considered. The Weather Bureau observations of wind velocity are made with the familiar cup anemometer, arranged to register the total movement. The observations of maximum velocity are obtained from the difference of two readings for a five-minute interval and are recorded for each hour of the day. The recorded velocities are made on the assumption that the velocity of the cups is one-third the true velocity of the wind, independent of the magnitude of the latter. It is now well known that this assumption is in error, and it has been shown[1] that the true relation is expressed by

$$\log V = 0.509 + 0.9012 \log v \qquad (1)$$

or

$$V = \log^{-1} [0.509 + 0.9012 \log v] \qquad (2)$$

where $V$ = true wind velocity,

$v$ = actual velocity of cup centers.

The error in the assumption before stated is not constant, but increases with larger values of velocity. Table I shows the Weather Bureau velocity and the true velocity at ten-mile intervals.

[1]Descriptive Meteorology, by Willis L. Moore; New York, 1910. Anemometry, third edition, by C. F. Marvin, Circular D, Instrument Division, United States Weather Bureau; Washington, D. C., 1907.

A curve can be constructed from Table I to obtain the true velocity for any value of observed velocity. No corrections were applied to the recorded velocities in making the study, which fact should be kept in mind in considering what follows.

TABLE I.—OBSERVED AND CORRECTED WIND VELOCITY IN MILES PER HOUR.

| Observed Velocity. | True Velocity. |
|---|---|
| 10 | 9.6 |
| 20 | 17.8 |
| 30 | 25.7 |
| 40 | 33.3 |
| 50 | 40.8 |
| 60 | 48.0 |
| 70 | 55.2 |
| 80 | 62.2 |
| 90 | 69.2 |
| 100 | 76.2 |

Before investigating the coincidence of wind and sleet it was thought best to analyze wind velocities independently and establish if possible a law of probability showing how often any given velocity might be expected to occur. This was carried out first on the basis of daily maxima covering a period of five years, from 1905 to 1909, inclusive. During the first five months and ten days of this period the station was situated on the Auditorium at an elevation of 274 ft. above the street, while for the remainder it was situated on the Federal Building at an elevation of 310 ft. This fact is not believed to prejudice the results materially, which may be concluded from the subsequent data and the fact that the major portion of the period comprises 91 per cent of the whole. The daily maxima during this period were classified in the order of their magnitude, as appears in Table II below.

This table exhibits the fact that Chicago's daily maximum winds seldom fall below twelve miles per hour. A calm of twenty-four hours' duration did not occur in the whole five-

TABLE II.—DAILY MAXIMUM WIND VELOCITIES AT CHICAGO, ILL., 1905 TO 1909.

| V. | Days. | V. | Days. | V. | Days. | V. | Days. |
|---|---|---|---|---|---|---|---|
| 6 | 2 | 22 | 67 | 38 | 41 | 54 | 3 |
| 7 | 1 | 23 | 68 | 39 | 16 | 55 | 1 |
| 8 | 2 | 24 | 127 | 40 | 29 | 56 | 2 |
| 9 | 3 | 25 | 89 | 41 | 12 | 57 | |
| 10 | 6 | 26 | 79 | 42 | 16 | 58 | 1 |
| 11 | 9 | 27 | 43 | 43 | 10 | 59 | 1 |
| 12 | 18 | 28 | 71 | 44 | 18 | 60 | 2 |
| 13 | 24 | 29 | 81 | 45 | 5 | 61 | |
| 14 | 39 | 30 | 101 | 46 | 14 | 62 | |
| 15 | 58 | 31 | 45 | 47 | 7 | 63 | |
| 16 | 57 | 32 | 53 | 48 | 23 | 64 | |
| 17 | 55 | 33 | 27 | 49 | 3 | 65 | |
| 18 | 61 | 34 | 46 | 50 | 6 | 66 | |
| 19 | 55 | 35 | 32 | 51 | | 67 | |
| 20 | 125 | 36 | 83 | 52 | 6 | 68 | 1 |
| 21 | 48 | 37 | 32 | 53 | 2 | | |

year period and the lowest maximum was six miles per hour. The velocities of twenty miles, twenty-four miles and thirty miles are especially predominant; this is apparent rather than real and is due probably to the failure to interpolate all readings which fell between the ruled lines of the record sheet. In order to eliminate this defect the observations were grouped in five-mile and ten-mile divisions, as shown in Table III.

Table III exhibits a very consistent appearance and shows that the most prominent velocities are between twenty miles and thirty miles per hour, with velocities exceeding fifty miles comparatively infrequent. This information has been employed in the compilation of a probability table showing the probability that any given velocity will occur in a twenty-four-hour period and the probability that the velocity will exceed a certain magnitude during a like period. These probabilities are easily convertible to any other period simply by multiplying them by the number of days in the desired period.

The probable daily maximum velocity is one between twenty-one and twenty-five-miles per hour, and it is equally probable that the maximum will be greater or less than this range. The values of probability in Table IV have been plotted in Fig. 1.

Velocities greater than seventy miles per hour will be exceedingly infrequent. A five-year period is inadequate, however, to study these extreme velocities and accordingly a study was made of the monthly maxima from 1873 to 1910. This

TABLE III.—SUMMARY OF DAILY MAXIMUM WIND VELOCITIES AT CHICAGO, ILL., 1905 TO 1909.

| V. | Days. | Days. |
|---|---|---|
| 0 to 5 | 0 | 14 |
| 6 " 10 | 14 | |
| 11 " 15 | 148 | 501 |
| 16 " 20 | 353 | |
| 21 " 25 | 399 | 774 |
| 26 " 30 | 375 | |
| 31 " 35 | 203 | 404 |
| 36 " 40 | 201 | |
| 41 " 45 | 61 | 114 |
| 46 " 50 | 53 | |
| 51 " 55 | 12 | 18 |
| 56 " 60 | 6 | |
| 61 " 65 | 0 | 1 |
| 66 " 70 | 1 | |
| Total..... | 1,826 | 1,826 |

study was divided into periods according to the location of the station during that time. The total period was 441 months, from June, 1873, to February, 1910; no observation was recorded for December, 1887, probably because the maximum was less than twenty-five miles.

Table V shows very clearly that the wind velocities increase

TABLE IV.—PROBABLE DAILY MAXIMUM WIND VELOCITIES AT CHICAGO, ILL.

| Velocity Interval. | Average Velocity. | Probability | |
|---|---|---|---|
| | | That the Velocity Will Occur. | That the Velocity Will Be Exceeded. |
| 0 to 5 | 2.5 | 0.0000 | 1.000 |
| 6 " 10 | 7.5 | .0077 | .992 |
| 11 " 15 | 12.5 | .0811 | .911 |
| 16 " 20 | 17.5 | .193 | .718 |
| 21 " 25 | 22.5 | .219 | .500 |
| 26 " 30 | 27.5 | .205 | .294 |
| 31 " 35 | 32.5 | .111 | .183 |
| 36 " 40 | 37.5 | .110 | .0729 |
| 41 " 45 | 42.5 | .0334 | .0394 |
| 46 " 50 | 47.5 | .0290 | .0104 |
| 51 " 55 | 52.5 | .0066 | .00383 |
| 56 " 60 | 57.5 | .0033 | .00055 |
| 61 " 65 | 62.5 | .0000 | .00055 |
| 66 " 70 | 67.5 | .00055 | .00000 |

with the elevation. But elevation alone is not a criterion, because surrounding objects such as trees and buildings play an important part. The contour of the surrounding country, if uneven or hilly, is also important. It will be noticed that as a whole the velocities on the Federal Building, at 310 ft. elevation, seem to be slightly less than the velocities on the Auditorium, at 274 ft. In this connection Mr. Cox states that the total wind movement observed on the Federal Building is about 10 per cent less than that on the Auditorium, caused by the fact that the former is situated among high buildings which afford some slight protection, while the latter is fully exposed.

The extreme maximum velocity observed in the whole thirty-six-year period was eighty-four miles per hour, in February, 1894. A velocity of seventy-six miles was observed once, in November, 1898, and a velocity of seventy-two miles was observed seven times. The most probable monthly maximum at the present location is one between forty-six miles and fifty miles per hour. Referring to Table IV, it will be seen that the velocity which will probably occur once every thirty days is

between forty-one miles and forty-five miles, which fairly checks the most probable maximum of Table V and is perhaps more reliable. No information is easily obtainable as to the extent to which the observatory was possibly shielded by surrounding buildings at its locations previous to 1890, but it is fairly presumable that such action was not prominent because very high buildings did not exist to any extent before that date. In order to study the effect of altitude it is necessary to prepare a table of probabilities from Table V. It may then be possible to make direct comparisons of equally probable velocities at unequal heights. The probabilities are given in Table VI and are plotted in Fig. 2.

TABLE V.—MONTHLY MAXIMUM WIND VELOCITIES AT CHICAGO, ILL., 1873 TO 1910.

| V. | MONTHS. June, 1873, to Dec., 1886. Elevation 103 Feet. | Jan., 1887, to Jan., 1890. Elevation 153 Feet. | Feb., 1890, to May, 1905. Elevation 274 Feet. | June, 1905, to Feb., 1910. Elevation 310 Feet. |
|---|---|---|---|---|
| 16 to 20 | 14 | | | |
| 21 " 25 | 50 | 1 | | |
| 26 " 30 | 61 | 6 | | |
| 31 " 35 | 22 | 6 | 1 | 1 |
| 36 " 40 | 13 | 14 | 10 | 10 |
| 41 " 45 | 2 | 8 | 17 | 13 |
| 46 " 50 | 1 | 1 | 58 | 19 |
| 51 " 55 | | | 39 | 8 |
| 56 " 60 | | | 33 | 5 |
| 61 " 65 | | | 9 | |
| 66 " 70 | | | 8 | 1 |
| 71 " 75 | | | 7 | |
| 76 " 80 | | | 1 | |
| 81 " 85 | | | 1 | |
| TOTAL..... | 163 | 36 | 184 | 57 |

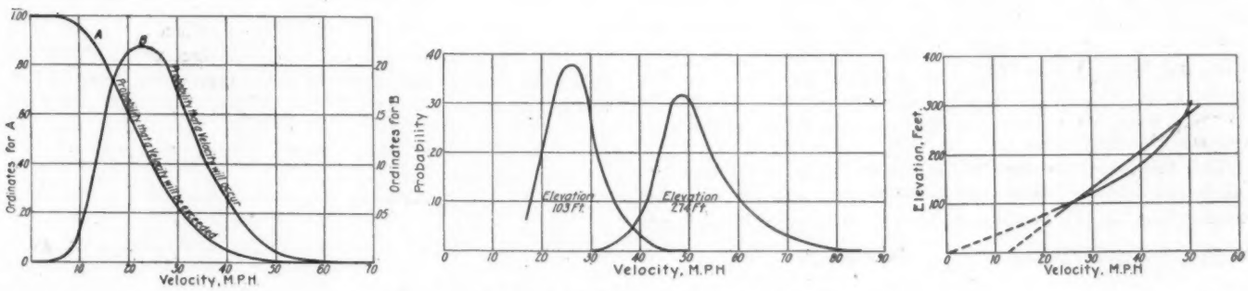
TABLE VI.—PROBABLE MONTHLY MAXIMUM WIND VELOCITIES AT CHICAGO, ILL.

| V. | PROBABILITY THAT THE VELOCITY WILL OCCUR. Elevation 103 Feet. | Elevation 153 Feet. | Elevation 274 Feet. | Elevation 310 Feet. |
|---|---|---|---|---|
| 16 to 20 | .086 | | | |
| 21 " 25 | .307 | .028 | | |
| 26 " 30 | .374 | .167 | | |
| 31 " 35 | .135 | .167 | .0054 | .018 |
| 36 " 40 | .080 | .389 | .054 | .175 |
| 41 " 45 | .0123 | .222 | .092 | .228 |
| 46 " 50 | .0061 | .028 | .315 | .333 |
| 51 " 55 | | | .212 | .140 |
| 56 " 60 | | | .179 | .088 |
| 61 " 65 | | | .049 | |
| 66 " 70 | | | .043 | .018 |
| 71 " 75 | | | .038 | |
| 76 " 80 | | | .0054 | |
| 81 " 85 | | | .0054 | |

The velocities at 310 ft. will be disregarded on account of facts previously stated. The others are plotted in Fig. 3. The two most reliable points on this plot are at 103 ft. and 274 ft. A straight line drawn through them indicates that the corresponding velocity at the ground level would be about thirteen miles per hour. The velocities at 153 ft. fall somewhat below the straight line and a curve passing through all three points would give substantially zero velocity at the ground. There are not sufficient points on the plot to give a wholly reliable curve, but the conclusion that the velocities nearer the ground decrease materially seems to be warranted. The conditions in a built-up city district are not very favorable for a study of the effect of elevation; the presence of buildings of uneven height and contour, with intersecting lanes composed of streets and alleys, causes eddies and counter currents which make unreliable any observations that are not made well above all surrounding objects.

TABLE VII.—PREDOMINANT MAXIMUM VELOCITIES.

| ELEVATION. | PREDOMINANT VELOCITIES (MAX.) |
|---|---|
| 103 feet | 26 |
| 153 " | 36 |
| 274 " | 48 and 50 |
| 310 " | 48 |




Figs. 1, 2 and 3—Probability Curves of Wind Velocity.

If the straight line of Fig. 3 is accepted, however, as a conservative basis for extrapolating the velocities at elevations below 100 ft., the maxima at several points corresponding to eighty-four miles per hour at 274 ft. and fifty miles at 100 ft. will be as found in Table VIII.

TABLE VIII.—MAXIMUM VELOCITY AT DIFFERENT ELEVATIONS.

| ELEVATION. | MAXIMUM VELOCITY. | |
|---|---|---|
| 274 feet | 84* | |
| 100 " | 45 | 50* |
| 50 " | 33 | 37 |
| 25 " | 27 | 31 |
| | *Observed. | |

Taking into account the conditions in cities it is very probable that the velocities at low elevations in open stretches of country will exceed those given in Table VIII. This amounts to much the same thing as saying that protecting objects are of the greatest importance in estimating maximum wind velocities in given localities. It is possible to compare the Chicago winds with those in a few representative localities from some investigations made by Mr. H. W. Buck.[2] The period covered

[2]The Use of Aluminum as an Electrical Conductor, by H. W. Buck, *Proceedings of the International Electrical Congress*, St. Louis, 1904.

is ten years, from about 1894 to 1903, inclusive, and the comparison appears in Table IX.

The maximum observed at Chicago is as high as that at any other locality except Buffalo, and all of the maxima range be-

TABLE IX.—MAXIMUM OBSERVED WIND VELOCITIES AT DIFFERENT PLACES, 1894 TO 1903.

| Locality. | Max. Velocity 1894 to 1903. |
|---|---|
| Chicago, Ill. | 84 |
| Bismarck, N. D. | 72 |
| Eastport, Me. | 78 |
| Buffalo, N. Y. | 90 |
| New York City, N. Y. | 78 |
| Galveston, Tex. | 84 |
| Savannah, Ga. | 76 |
| Salt Lake City, Utah. | 60 |

tween sixty miles and ninety miles per hour. It will be recalled that these are uncorrected observations for five-minute intervals, or possibly one-minute intervals in some cases. The puffy or gusty character of winds is well known, and it is to be expected that the instantaneous maxima are considerably greater than those given by the Weather Bureau. That this is a fact has been proven by observations made with the Dines pressure tube anemometer. A chart of instantaneous pressures recorded by this apparatus[3] shows that the extreme maximum is about 50 per cent in excess of the average for short periods. The very uneven character of the puffs is clearly shown, but winds differ much in this respect at different times and places.

If the observed velocities are corrected by means of the curve in Fig. 4 and are then increased 50 per cent, the results given in Table VIII will be changed to those shown in Table X.

TABLE X.—CORRECTED MAXIMUM INSTANTANEOUS VELOCITY AT DIFFERENT ELEVATIONS.

| Elevation. | Maximum Velocity. | |
|---|---|---|
| 274 feet | 98 | |
| 100 " | 56 | 61 |
| 50 " | 42 | 47 |
| 25 " | 35 | 40 |

Table X shows that where wind pressures alone are to be considered a velocity of forty-seven miles per hour may be assumed in calculations for transmission lines with tower construction and forty miles for ordinary pole lines. In exposed localities where the wind has a wide, free sweep these velocities should be increased somewhat, probably to sixty miles and forty-eight miles, respectively, at least. Mr. Buck concludes from his analysis that at the elevation of ordinary transmission lines the velocity is about 30 per cent less than at altitudes of 100 ft. or more. The Weather Bureau observations are generally taken at elevations of more than 100 ft. It is a fact also that maximum velocities do not generally occur at very low temperatures.

Reviewing this analysis of maximum wind velocities it appears that the data of the Chicago Observatory form a safe basis for most of the country. They are perhaps high if anything, but the error will be on the safe side. Every locality should be investigated by itself, of course, when the safety of important construction is in question, but Table IX indicates that the differences between representative localities are not very great as a whole. The direction of prevailing winds and especially the direction of storms are quite important in relation to transmission lines and pole lines. When the direction of a line lies in the path of prevailing storms it requires less reinforcement than lines transverse to or having some angularity with the storm path. This fact has an important bearing upon the character of storm guys needed, but is almost entirely a local problem.

[3]Descriptive Meteorology, by Willis L. Moore, New York, 1910; page 177, Fig. 61.

### WIND VELOCITY AND WIND PRESSURE.

There have been numerous experiments to determine the relationship between wind velocities and pressures. Some brief account[4] of the matter is given by the writer in a treatment of the subject of transmission line crossings. Smeaton's formula is:

$$P = 0.005\,V^2. \tag{3}$$

The experiments by Langley gave

$$P = 0.0036\,V^2. \tag{4}$$

The results of the work done by the Weather Bureau are expressed by

$$P = 0.004\left(\frac{B}{30}\right)V^2 \tag{5}$$

where

$P$ = pressure in pounds per square foot on a flat surface normal to the wind,

$V$ = wind velocity in miles per hour,

$B$ = barometer reading in inches.

Borda's experiments with cylindrical surfaces show that the pressure is equal to one-half the pressure on a projected plane surface with the wind normal. Taking the Weather Bureau formula and neglecting the barometer indications, the normal wind pressure on cylindrical smooth wires will be

$$P = 0.002\,V^2. \tag{6}$$

Mr. Buck's experiments with wind pressures on a stranded cable resulted in the formula

$$P = 0.0025\,V^2. \tag{7}$$

Wind pressures do not ordinarily produce severe loads on pole lines or wire spans, except in the case of cyclones or tornadoes, or at very great altitudes. The most severe condition

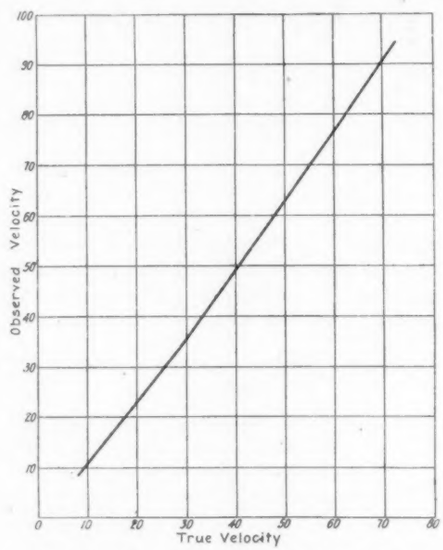



Fig. 4—Observed and True Velocity Curve.

exists when structures and wires are encased in sleet or wet snow. Under such circumstances there is not only the dead load of sleet or snow, but a largely increased wind load caused by the increased surface. The combination of sleet and wind is much the most severe condition encountered where sleet storms occur.

### WIND VELOCITY AND SLEET.

There have not been a great many data on the maximum wind velocities during the precipitation of sleet, but such data are manifestly desirable and valuable; without them the factor of safety in many structures or spans is at best an uncertain quantity, or, what is worse, it may not exist at all. It is, therefore, important to collect all the data available on this question. The records of the Chicago Observatory were searched for the period from 1900 to 1909, inclusive, or ten years, to gather such

[4]Transmission Line Crossings, by F. F. Fowle, New York, 1909.

data. As the results are important and will be discussed in some detail, they are presented in full in Table XI.

TABLE XI.—SLEET STORMS OBSERVED AT CHICAGO, 1900 TO 1909.

| Date. | Character of Sleet Precipitation. | Max. Wind Vel. | REMARKS. |
|---|---|---|---|
| Feb. 3, 1900 | Light | 27 | |
| Feb. 4, 1900 | Light | 41 | |
| Mar. 5, 1900 | Nearly 2 inches | 45 | |
| Mar. 6, 1900 | Nearly 2½ inches | 53 | |
| Mar. 14, 1900 | Moderate | 32 | |
| Nov. 17, 1900 | Considerable | 40 | |
| Jan. 9, 1901 | Moderate | 48 | |
| Nov. 3, 1901 | Trace | 33 | |
| Dec. 13, 1901 | Moderate | 48 | Extreme velocity 57 m.p.h. |
| Nov. 29, 1902 | Trace | 50 | |
| Dec. 10, 1902 | Considerable | 30 | |
| Dec. 11, 1902 | Considerable | 30 | On Dec. 12 maximum velocity was 54 m.p.h. |
| Feb. 3, 1903 | Heavy | 50 | Extreme velocity 54 m.p.h. |
| Mar. 17, 1904 | Moderate | 26 | |
| Mar. 20, 1904 | Moderate | 30 | On Mar. 21 maximum velocity was 42 m.p.h. |
| Mar. 25, 1904 | Light | 34 | |
| Dec. 26, 1904 | Heavy | 28 | On Dec. 27 maximum velocity was 72 m.p.h. and extreme velocity was 86 m.p.h. Temperature fell. |
| Jan. 11, 1905 | Not over ½ inch | 44 | |
| Jan. 19, 1906 | Moderate | 29 | |
| Jan. 22, 1906 | Heavy | 38 | |
| Nov. 19, 1906 | Light | 22 | |
| Jan. 17, 1907 | ½ inch | 14 | On. Jan. 18 maximum velocity was 18 m.p.h. and on Jan. 19, 52 m.p.h. Warm. |
| Mar. 7, 1907 | Trace | 24 | |
| Nov. 30, 1907 | Moderate | 26 | |
| Dec. 22, 1907 | Heavy | 24 | On Dec. 23 maximum velocity was 29 m.p.h. and on Dec. 24, 37 m.p.h. |
| Dec. 28, 1907 | Trace | 37 | |
| Jan. 11, 1908 | Trace | 36 | |
| Jan. 12, 1908 | Rain and wet snow | 41 | |
| Feb. 5, 1908 | About ½ inch | 54 | |
| Feb. 14, 1908 | About ½ inch | 42 | |
| Feb. 29, 1908 | Moderate | 30 | |
| Jan. 28, 1909 | Trace | 38 | |
| Feb. 14, 1909 | 0.8 inch | 48 | |
| Apr. 7, 1909 | Trace | 60 | |
| Apr. 28, 1909 | ½ inch | 42 | |
| Nov. 22, 1909 | Light | 44 | |
| Nov. 24, 1909 | Light | 22 | |
| Dec. 5, 1909 | Moderate | 52 | |
| Dec. 11, 1909 | Heavy | 27 | |
| Dec. 12, 1909 | Not over 0.4 in. | 18 | On Dec. 13 maximum velocity was 36 m.p.h. Temperature fell. |

Table XI covers a period of ten years, in which there were thirty-four sleet storms, extending over a period of forty days in the records. The average was 3.4 storms per year. The storms may be classified as follows:

| | |
|---|---|
| Trace of sleet | 6 |
| Light sleet | 4 |
| Moderate sleet | 10 |
| Considerable sleet | 6 |
| Heavy sleet | 7 |
| Total | 33 |

Sleet storms of a serious character appear to occur about twice a year and heavy storms not quite once a year. A number of important conclusions can be drawn from Table XI, which are next enumerated:

1. The maximum recorded sleet precipitation was nearly 2.5 in., with an observed maximum wind velocity of fifty-three miles per hour.

2. A sleet precipitation of at least 1 in. may be expected occasionally, and 0.5 in. frequently.

3. The maximum recorded velocity during a sleet storm was sixty miles per hour.

4. In the wake of a sleet storm it may happen that:
(*a*) the temperature falls,
(*b*) the wind rises,
(*c*) or both occur.

5. Following a precipitation of sleet there may be a precipitation of wet, adhesive snow.

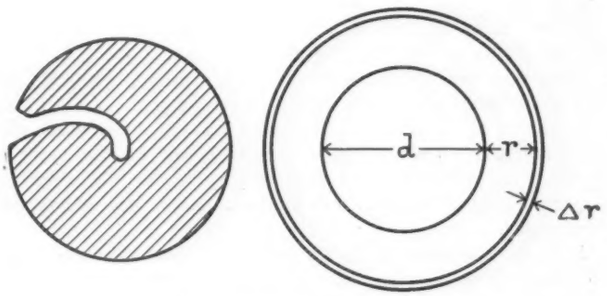
6. An extreme wind velocity of eighty-six miles per hour was observed after one heavy storm, with falling temperature.

It appears from these conclusions that one must reckon with the conditions which follow a storm, as well as the storm itself. Falling temperature and rising wind after a storm may cause the principal damage, for under such conditions the sleet will remain. The extreme velocities noted under remarks in Table XI were presumably taken for one-minute intervals; the ordinary recorded maxima are taken for five-minute intervals. A summary of the observed maxima during the storms is given in Table XII.

TABLE XII.—OBSERVED MAXIMUM WIND VELOCITIES DURING SLEET STORMS, AT CHICAGO, ILL.

| V. | DAYS. | |
|---|---|---|
| 11 to 15 | 1 | 1 |
| 16 " 20 | 1 | 5 |
| 21 " 25 | 4 | |
| 26 " 30 | 10 | 13 |
| 31 " 35 | 3 | |
| 36 " 40 | 5 | 12 |
| 41 " 45 | 7 | |
| 46 " 50 | 5 | 8 |
| 51 " 55 | 3 | |
| 56 " 60 | 1 | 1 |
| TOTAL..... | 40 | 40 |

The most frequently observed velocity was between twenty-six and thirty miles per hour, with a maximum of sixty miles. On one occasion a maximum of seventy-two miles was observed the day following a storm, with an extreme maximum of eighty-six miles and a temperature below 32 deg. Fahr. This observation was taken at an elevation of 274 ft. On a number of other occasions, also, the wind rose on the day after the storm.




Figs. 5 and 6—Sleet on Wire.

The general probability that very high winds will occur is exceedingly small, as shown in Figs. 1 and 2. Yet such velocities will occur during or in the wake of sleet storms, at long intervals, and should be taken into account. On the occasion of a severe storm in Chicago, within the writer's experience, sleet accumulated on telephone and telegraph wires to a diameter of about 2 in. and remained several days. When it finally melted sections of it which had fallen from the few wires that remained on the poles presented an interesting fact. The outside diameter of sleet had not apparently diminished very much, although the temperature had risen somewhat, but the wire had melted through the sleet in a curious manner, as shown in Fig. 5.

The curved path made by the wire through the sleet can be explained by the effect of wind, which increasingly deflected the sleet from a position of equilibrium as the wire progressed toward the circumference. Had there been no wind the path would have been straight, along a radius. The general form of sleet accumulations on wires is cylindrical or approximately

so. There are no data bearing upon the relationship between precipitation and the thickness of formations on wires, so far as known. The following theoretical discussion is, therefore, submitted as of general interest.

Assume a cylindrical wire of diameter $d$, with a uniform concentric sleet load of radial thickness $r$, as shown in Fig. 6. Assume also that the sleet precipitation is uniform, at the rate $p$. The amount of sleet which strikes the wire will be equal to that passing through the projected area of the wire, normal to the direction of precipitation.

In the time $\Delta t$ the volume of precipitation which impounds on the wire in a unit of length will be

$$\Delta V = p\,(d+2r)\,\Delta t. \qquad (8)$$

Assuming that this volume distributes itself uniformly around the wire, the increase in sleet thickness $\Delta r$, caused by the precipitation $\Delta V$ in the time $\Delta t$, will be

$$\Delta r = \frac{p\,(d+2r)\,\Delta t}{\pi\,(d+2r)} = \frac{p}{\pi}\,\Delta t \qquad (9)$$

or

$$r = \frac{p\,t}{\pi} \qquad (10)$$

That is, the radial thickness of a uniform sleet deposit resulting from a total precipitation of $p\,t$ inches will be $\frac{p\,t}{\pi}$ inches, regardless of the diameter of the wire. This can be expressed as

$$r = 0.318\,p\,t \qquad (11)$$

or

$$d' = 2r = 0.637\,p\,t \qquad (12)$$

where $d'$ is the diameter of sleet, exclusive of the wire. Approximately, then, the sleet diameter will be 64 per cent of the total precipitation. This result is wholly theoretical and assumes that all the sleet which strikes the wire will stick there. Until some data can be gathered to corroborate it, the constants must be used with caution, but at the same time it is difficult to see any flaw in the reasoning.

Referring to Table XI, the greatest precipitation noted in any storm was 2.5 in., on March 5 and 6, 1900. Assuming that the total of the two days was entirely cumulative, the sleet diameter on wires would have been 2.87 in. So great a diameter is probably very rare, but the writer has observed approximately 2 in., so that the former is not altogether improbable.

It is entirely probable that a coefficient should be inroduced to differentiate between different wire substances, but almost no information on this matter is available. There is a good deal of testimony to the effect that aluminum is practically immune from sleet, owing to the greasy character of its surface oxide. Taking this to be a fact, aluminum has then an important advantage over copper for transmission cables in sleet zones. But whether it is immune alike from sleet and wet snow under all conditions does not yet appear to be established.

There is one more factor to be considered in sleet formations, relating to transmission cables. The temperature range of sleet storms is exceedingly limited, and consequently a small temperature elevation will practically prevent sleet formation. Such a condition exists in overloaded cables; it often occurs in railway feeders and sometimes in transmission lines. The load factor is seldom high enough and the wasted energy is too great to make this a generally dependable protection, but it is undoubtedly effective. The questions whether electrostatic attractions and repulsions come into play on high-tension lines, and whether sleet will form on lines about which there are corona, seem to be open. The energy loss in the corona must be dissipated as heat and it would be reasonable to suppose that sleet formation would therefore be lessened or perhaps prevented. It seems unlikely in any case that sleet would remain long on live cables.

The calculation of loads due to combined wind and sleet is usually made on the assumption that the former is horizontal and normal to the line, and the two forces are combined in the usual manner. This is not correct in strict theory if the sag of the span is relatively great compared to the length, but for ordinary spans it is undoubtedly true for all practical purposes. A steady horizontal wind pressure theoretically deflects the span until the moment due to gravity is equal to the moment due to wind pressure. But the puffy character of the wind usually sets the span into oscillation. Such oscillations in lines carrying numerous wires in short spans are frequently serious and are sometimes the direct cause of pole failures when the spans swing in synchronism. Storm guys must be relied upon to reduce the serious consequences of such effects.

The formula for wind pressure on smooth wires, in pounds per foot of length, is

$$p = \left(\frac{d+2r}{6{,}000}\right)V^2 \qquad (13)$$

where

$d$ = wire diameter in inches,
$r$ = radial thickness of sleet in inches,
$V$ = wind velocity in miles per hour, corrected.

Assuming the weight of sleet as 57.5 pounds per cubic foot, the formula for sleet load per foot of length is

$$w = 1.254\,r\,(d+r) + w_1 \qquad (14)$$

where $w_1$ = weight of the wire or cable in pounds per foot.

The combined load in pounds per foot is

$$W = \sqrt{w^2+p^2} \qquad (15)$$

The effect of sleet in increasing the wind pressure, resulting from increased surface, is quite apparent from (13). The effect is most noticeable with small wires. The most severe imaginable case of loading occurs when the wind pressure is vertically downward, when the wind and sleet loads are directly cumulative. This case rarely occurs and then only in unusual localities, where natural formations make it possible.

In conclusion it may be remarked that this study disposes in part of the numerous doubts which have heretofore existed in regard to combined loads of wind and sleet. It is to be hoped that investigators in other localities will take up the subject as opportunity affords and gather new data.

## GRAPHIC REPRESENTATIONS OF THE LINEAR ELECTROSTATIC CAPACITY BETWEEN EQUAL PARALLEL WIRES.

By A. E. Kennelly.

In an article[1] appearing in these columns in the issue of Sept. 22, 1910, Messrs. H. Pender and H. S. Osborne pointed out the errors which existed in certain tables of linear electrostatic capacities of overhead wires, owing to the misapplication of a certain well-known approximate formula to cases where the interaxial distances separating the wires are less than 60 diameters, and especially when they are less than 6 diameters. They demonstrate the interesting new proposition that the surface density of charge on opposed parallel cylinders is represented by an ellipse, with the axis of the cylinder at one focus, and they substituted correct antihyperbolic formulas for the inaccurate approximative formulas in discussing short interaxial distances.

The proposition that the fundamental formula of linear capacity between equal parallel wires involved antihyperbolic functions of the type

$$c = K/\cosh^{-1} x \quad . \quad . \quad . \text{ farads per unit length,} \qquad (1)$$

was first published by the writer, in a paper[2] which pointed out

[1] "The Electrostatic Capacity Between Equal Parallel Wires," by H. Pender and H. S. Osborne. *Electrical World*, Vol. LVI, No. 12, pages 667-670.

[2] "The Linear Resistance Between Parallel Conducting Cylinders in a Medium of Uniform Conductivity," by A. E. Kennelly, *Proceedings* American Philosophical Society, Vol. XLVIII, April 24, 1909, pp. 142-165.

that not only the linear capacity, but also the potentials, resistances, conductances and linear currents between such parallel cylinders, whether equal or unequal, are naturally and simply expressed in antihyperbolic functions. A reference table of 178 entries between the limits of 1.01 and 5000 for $x$, the ratio of interaxial distance to diameter, was also appended.

A curve sheet is here presented in the accompanying Fig. 1 showing the graphs of $\cosh^{-1} x$, $1/\cosh^{-1} x$, and linear capacities of equal, parallel, round wires in air, for values of $x$ less than 25—that is, for interaxial distances less than 25 diameters. Such graphs have less precision than numerical tables of linear capacity for wires of a given size at stated distances apart, such as appear in the recent paper of Messrs. Pender and Osborne, but graphs have the advantages of presenting the results collectively to the eye and of offering continuous solutions for all intermediate values of the variable $x$.

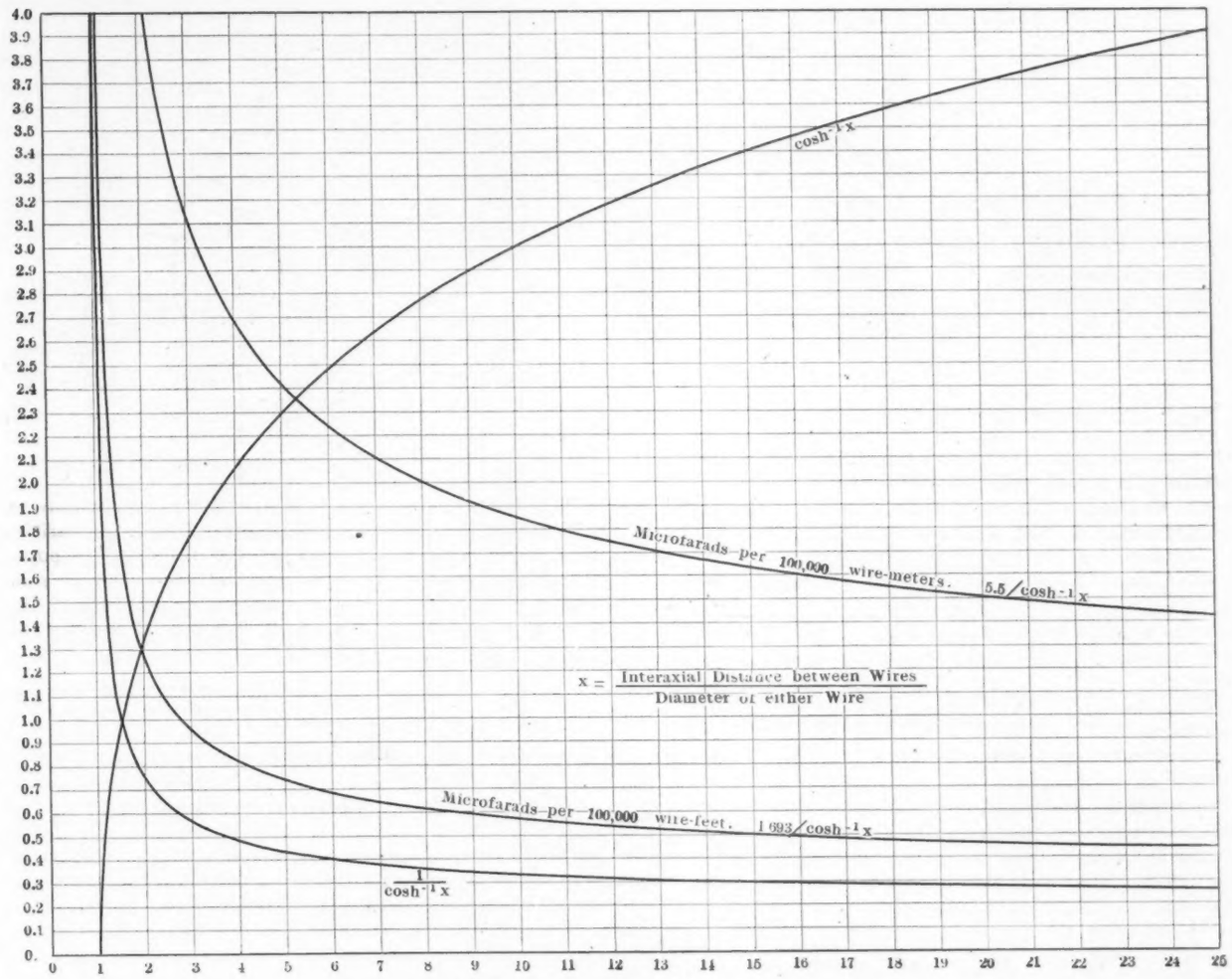

cosh⁻¹x
Microfarads per 100,000 wire-meters. 5.5/cosh⁻¹x
x = Interaxial Distance between Wires / Diameter of either Wire
Microfarads per 100,000 wire-feet. 1.693/cosh⁻¹x
1/cosh⁻¹x

**Fig. 1—Linear Capacity per 100,000 Wire-Feet and Wire-Meter.**
**Graphs of $\cosh^{-1}x$, $1/\cosh^{-1}x$, and linear capacities of bare, equal, parallel, round wires in air for interaxial distances up to 25 diameters.**

In dealing with the linear capacity of transmission lines, it is probably easier to consider and discuss capacities per wire-unit-length than capacities per loop-unit-length. In cases of single-phase transmission lines there is not much advantage in favor of one or the other of these quantities, but in cases of polyphase transmission lines, there is distinct advantage in favor of the former. The linear capacity of a wire-kilometer, for instance, may be defined as the capacity of one wire per kilometer of a transmission line, as measured between that wire and the neutral-potential surface. In the case of a symmetrical three-phase line, that surface will be the surface of zero potential or of neutral potential. In the case of a single-phase line, the neutral-potential surface will be the infinite midplane between the wires. In any overhead line the linear capacity per "loop-kilometer," or kilometer of loop, is, therefore, always half the linear capacity per "wire-kilometer," just as reciprocally the inductance per loop-mile is always twice the inductance per wire-mile. The advantage of dealing with the linear capacity of a short three-phase line per wire-kilometer is that if we multiply the impressed star-branch voltage at the generator end of the line by the linear capacity per wire-kilometer, we obtain immediately the charging current per kilometer of line, whereas if we use the linear capacity per loop-kilometer we have to make an additional step in the reasoning and computation.

In Fig. 1 the linear capacity is given in microfarads per 100,000 wire-meters and in microfarads per 100,000 wire-feet.

Thus, if we take a pair of No. 4-0 wires (diameter 0.46 in. = 1.168cm) at an interaxial distance of 1 in. (2.54 cm), we have $x = \frac{1}{0.46} = \frac{2.54}{1.168} = 2.174$; and on referring to Fig. 1 we find for $x = 2.174$, $y = 1.2$ microfarads per 100,000 wire-feet, or 3.94 microfarads per 100,000 wire-meters. If we need the linear capacity per loop length, we would take half these values, or 0.6 microfarad per 100,000 loop-feet and 1.97 microfarads per 100 loop-km. That is, two such parallel wires, each 100 km long, and forming between them a loop 100 km long, would offer a condenser capacity of 1.97 microfarads when tested against each other with other conductors remote. This result agrees with that given in the corrected table of the Pender and Osborne paper above mentioned.

In Fig. 2 the graphs of linear capacity per wire-length are given for interaxial distances between 25 diameters and 10,000 diameters—that is, for cases in which $\cosh^{-1} x$ does not appreciably differ from $\log_e(2x)$; so that the ordinary approximate formulas are applicable. By using abscissas to logarithmic scale and ordinates to a scale of reciprocals, these graphs become converted into straight lines. There are advantages in the use of straight-line graphs that are probably worth securing at the expense of non-uniformity of gradation along the co-ordinate axes.

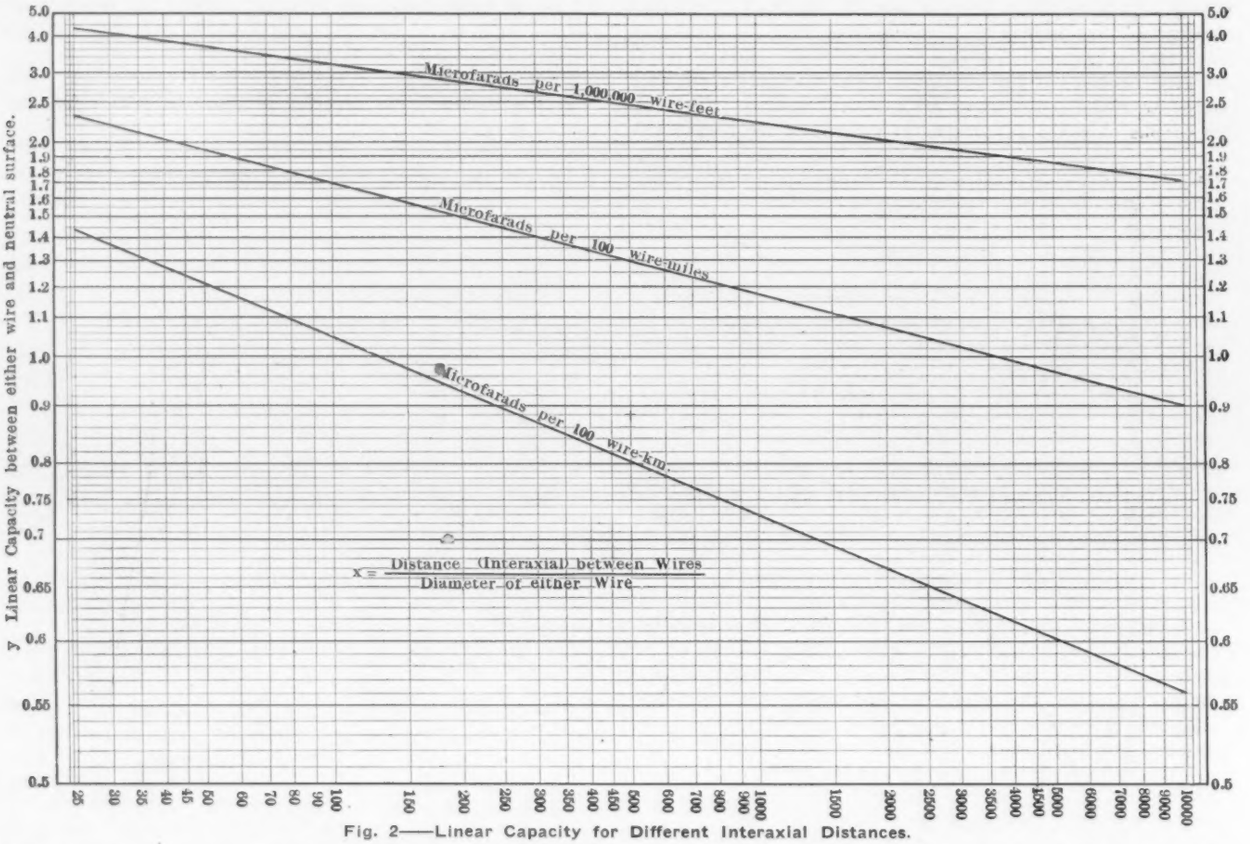

y Linear Capacity between either wire and neutral surface.
Microfarads per 1,000,000 wire-feet.
Microfarads per 100 wire-miles.
Microfarads per 100 wire-km.
x = Distance (Interaxial) between Wires / Diameter of either Wire

Fig. 2——Linear Capacity for Different Interaxial Distances.

Graphs of linear capacity of bare, equal, parallel, round wires in air for interaxial distances from 25 to 10,000 diameters, in microfarads per 1,000,000 "wire-feet," per 100 "wire-miles" and per 100 "wire-kilometers"; $y = \frac{16.93}{\cosh^{-1} x}$ mf. per 1,000,000 wire-feet; $y = \frac{8.941}{\cosh^{-1} x}$ mf. per 100 wire-miles; $y = \frac{5.555}{\cosh^{-1} x}$ mf. per 100 wire-kilometers.

As an example, if we consider a pair of No. 4-0 wires as before, but suspended at an interaxial distance of 72 in. (182.8 cm), we have $x = \frac{72}{0.46} = \frac{182.8}{1.168} = 156.5$. By reference to Fig. 2, with this value of $x$, we find $y = 0.97\ \mu f$ per 100 wire-km, $1.56\ \mu f$ per 100 wire-miles and $2.94\ \mu f$ per 1,000,000 wire-feet. That is, 1 wire-km would offer 0.0097 microfarad, 1 wire-mile 0.0156 microfarad, and 1000 wire-feet 0.00294 microfarad, all as measured between one wire of the system and the neutral or zero-potential surface. The linear loop capacities would be the halves of these values respectively.

The precision of such a graph is necessarily limited on a small-scale diagram, but in practice the linear capacity of wires is not only difficult to measure experimentally with precision, but various disturbing factors introduce deviations from the computed values[2] and always in the positive direction, or direction of excess—that is, the presence of neighboring conductors and the electrostatic capacities of the insulators—so that the graphs are likely to be of sufficient precision for practical purposes.

[2] "The Inductance and Capacity of Suspended Wires," by E. J. Houston and A. E. Kennelly, *Electrical World*, Vol. XXIV, No. 1, July 7, 1894, pp. 6-7.

## THE TRACKLESS TROLLEY AT LOS ANGELES.

By R. W. Shoemaker.

The first commercial trackless trolley in America has lately been installed in Laurel Canyon, near Los Angeles, Cal., for the purpose of handling passengers from the lines of the Los Angeles Pacific Railroad Company to "Bungalow Land," a real-estate subdivision in the hills northwest of the city.

The road traversed is mostly curves, there being only 1000 ft. of tangent in the mile and a half, the grade ranging from 5 to 12 per cent, and not especially even; in fact, the course is what might be called an ordinary country road, and hence is a road well suited to test the practicability of the system.

Transportation previous to the installation of the trolley system was by means of automobiles, but these proved too uncertain, while, owing to the grades, the maintenance was excessive; moreover, such a transportation system lacks the substantiality necessary to an enterprise of this character. The expense of constructing a track and overhead work for a regular traction system would have been excessive, as the road is in a pass in the hills and would be ruined for automobiles, which pass over the route in considerable numbers, and the scenery would also have been marred to a considerable extent. For these reasons the trackless trolley seemed to be the logical solution, combining simplicity, reliability, economy in first cost and low operating charges.

The old gasoline motor buses, two in number, were stripped of the original motive power and fitted with two especially designed and constructed motors of 15-hp rating, 500 volts, each motor driving one rear wheel by chain, thus eliminating the differential. The control is by means of a series-parallel controller mounted on the dash to the left of the steering wheel, the reverse switch being separate under the driver's seat and operated by a handle to the right of the wheel. The usual ex-

panding and contracting brakes are fitted as in a regular automobile.

The trolleys are mounted forward on the roof of the bus, approximately 24 in. back of the front axle and spaced 48 in. apart, which is also the spacing of the trolley wires. The poles themselves are of wood 15 ft. long and carry a special swiveled form of collector at the end, which is arranged to slip off without damage in case the pole should leave the wire and the collector catch on the overhead. This collector consists of an aluminum shoe supported on a light spring and having a vertical movement of ¾ in. in a swiveled guide; this enables the shoe to keep the proper position on the wire regardless of the horizontal angle the trolley pole happens to be making with the trolley wire.

The trolley system allows a total variation of 11 ft. each side of the center of the roadway, and at slow speed will operate when the trolley poles have an angle of 75 deg.; it also allows the car to be completely reversed in direction under the wires without change, although it is, of course, necessary to turn the poles after the car has turned and before it can proceed, as the poles are crossed and project forward of the car.

The trolley wires are No. 3-0 copper conductors suspended from pipe arm brackets fastened to telephone poles along the roadway, these being sometimes on the right and sometimes on the left-hand side of the road; the cars, however, always obey the rule of the road and pass to the right of approaching vehicles regardless of the location of the trolley wires. On some of the sharp turns two or more pipe arms are spread fan-wise from the poles, thus making an even curve on the trolley wire where otherwise there would be a sharp angle. A speed of twenty-five miles per hour is possible on a straightaway course, but ten miles per hour is all that is desired or used on the curved portions of the line.

From the success attained with this road, both from a financial and an engineering standpoint, it is certain that there are numerous cases in the country where like roads could be profitably constructed. For wherever there are two places between which a certain amount of travel could be expected and yet not enough to warrant the purchase of a right-of-way, etc., necessary for a railway, it would be only necessary to string two wires along the highway on the telephone poles that in almost all cases exist on the main roads between towns and operate a trackless trolley. As the investment is small, a very moderate amount of travel is all that is required to pay good returns.

A further application that promises to be of greater importance is the use of the trackless trolley in transporting freight to mining camps remote from a railroad, which, owing to various causes, cannot be reached by a railroad and have to depend on freight teams for supplies.

A trackless trolley would have no difficulty whatever in traversing any road over which it is possible to drive freighting teams and at a much greater speed and with less expense.

The system in Laurel Canyon is owned by the Laurel Canyon Utilities Company, of Los Angeles, Mr. Charles S. Mann, president, and the line and electrical apparatus were designed and furnished by the writer.

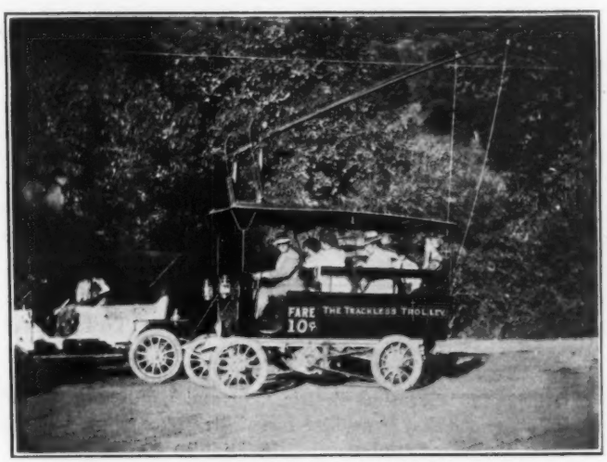



Fig. 1—View of Car.

Fig. 2—Junction with the Los Angeles Pacific Railway.

# Central Station

## Management, Policies and Commercial Methods

### CENTRAL-STATION SERVICE GROWTH IN TOLEDO, OHIO.

The increasing industrial importance of Toledo has found the local central-station company, the Toledo Railways & Light Company, which also operates the street-car system and gas-supply business, almost unable to keep pace with the demand for motor and lighting service in spite of the additions of new machinery. During the past year the railway load on the company's generating station increased 29 per cent, the Edison direct-current load 36 per cent and the motor load 62 per cent. To meet this increased demand a 6000-kw, 4000-volt, 25-cycle Allis-Chalmers turbine-generator set is being installed, bringing the generating station's total rating up to 20,000 kw. This plant is unique in the respect of the diversity of kinds of service generated and transmitted, including 25-cycle and 60-cycle three-phase alternating current at several voltages, 110-220-volt direct-current service, 550-volt electric railway service and rectified current for the city magnetite arc lamps. The company is now erecting a substation in East Toledo at a point on the bank of the Maumee River just opposite the generating station, with which it is connected by a submarine 4000-volt cable. This substation will supply 2000 kw for railway purposes and 400 kw for lighting, while a second block of 2000 kw will be transmitted through the station to a transmission line. The Toledo company has 12,000 connected electrical customers out of the city's population of 170,000. Mr. W. E. Richards is superintendent of the company.

## N. E. L. A. COMMERCIAL SECTION.

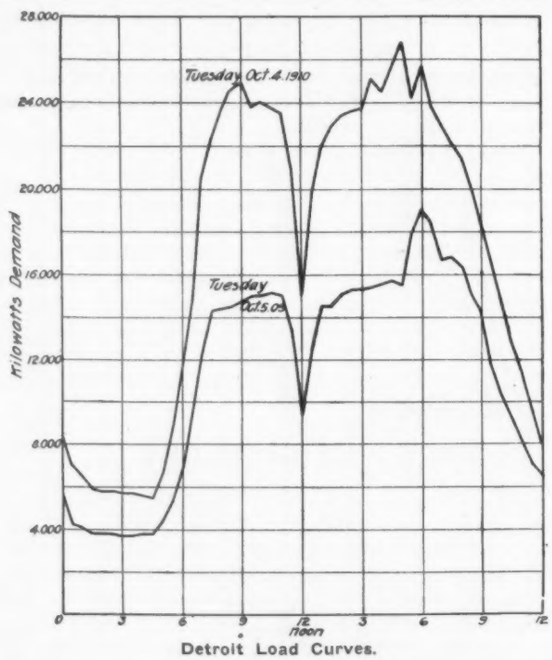
At the St. Louis convention the National Electric Light Association appointed a committee as follows on the organization of a Commercial Section of the association: Messrs. George Williams, chairman; J. E. Becker, E. L. Callahan, F. H. Gale, J. R. Crouse, L. D. Gibbs, H. J. Gille, V. A. Henderson, T. I. Jones, C. W. Lee, E. W. Lloyd, H. C. Mohr, M. C. Rypinski, C. N. Stannard; Frank B. Rae, Jr., secretary.

The first meeting of this committee was held in the rooms of the association, New York City, on Oct. 17 at 11 a. m., the sessions continuing until evening. A plan of organization with constitution and by-laws was presented by Chairman Williams and was unanimously adopted. This plan provides for the formation of a commercial committee with chairman and secretary as officers. Each member of the commercial committee is in turn chairman of a sub-committee appointed to investigate and report upon a specific department of central-station commercial work. Through this plan of organization it is hoped that the association will have each year very complete and authoritative reports of commercial progress instead of papers by individual authors as in the past.

The first meeting of the committee was given over largely to discussion of the plan of organization and selection of subjects to be taken up by the sub-committees. At the conclusion of the session it was determined to call a second meeting on Nov. 10 at Pittsburgh, where nominations for the various committees would be made and their work outlined in full.

## DETROIT EDISON COMPANY'S OUTPUT INCREASED 52 PER CENT LAST YEAR.

Aside from the well-known progressive policy of the local company, for several years Detroit has had a reputation among central-station men on account of its large number of residences served with electric light. In fact, with a city population



Detroit Load Curves.

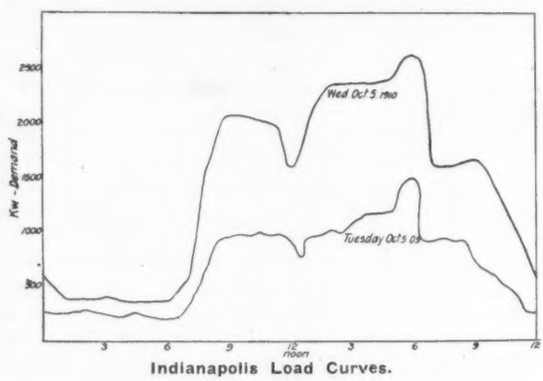
of 466,000, as shown by the 1910 census, to which may be added another 100,000 to account for the adjacent suburban territory, the Edison Illuminating Company of Detroit now has nearly 22,000 residence customers. In the past eighteen months the selling organization of the company, headed by Miss Sheridan, has turned its attention as well to the securing of large power business, with the result shown by the accompanying load curves, in which the hourly demands are shown for the same day in 1909 and in 1910. These indicate an increase in demand, continuing throughout almost all the hours of the day, of nearly 10,000 kw. The monthly output increased from 7,181,430 kw-hours in September, 1909, to 10,932,000 kw-hours in September, 1910—a gain of 51.6 per cent. Of both these amounts about 2,000,000 kw-hours were sold to the local railways company. During the year 11,194 hp in connected motors were added to the lines of the company, indicating, from the increased demand of 10,000 kw as shown by the load curves, that the already existing installations were being worked at an increased load factor.

Meanwhile the accession of new business in the various other departments of the service was not being neglected. Of the even 1000 new customers obtained during last month 66 per cent were residence installations, 24 per cent were commercial-lighting customers and 10 per cent were motor-service installations.

An increase of over 50 per cent within one year's time in the demand and the delivered output of a large central-station system like that of the Detroit Edison Company is unusual, and the accompanying contrast of load curves is interesting in showing the substantial, healthy character of the growth recorded.

## CORLISS ENGINE FOR BIG TURBINE STATION AT INDIANAPOLIS.

To serve its increasing electric light and motor service and steam-heating business the Merchants' Heat & Light Company, of Indianapolis, is installing a 10,000-hp Allis-Chalmers engine-



Indianapolis Load Curves.

driven generator in one of its local power plants, where 10,000 kw in turbo-generating apparatus is already in operation.

The motor-service business, to which this company chiefly confines itself, has increased 66 per cent during the past year. The accompanying load curves show the demand on one of the stations of the Merchants' company for two typical days—Oct. 5, 1909, and Oct. 5, 1910. The total demand of the company's service is divided evenly between the Pearl Street and West Washington Street stations, so that these curves provide an index of the growth that has occurred. The taking on of motor business has been accompanied by the replacement of many isolated plants, one of the largest of these being the 250-kw steam turbine and auxiliary plant of the Sanitary Can Company, at Indianapolis, for which motor drive was substituted.

## CENTRAL-STATION ILLUMINATING ENGINEERING AT DENVER.

In a paper presented at the Baltimore convention of the Illuminating Engineering Society on Oct. 24 Mr. C. F. Oehlmann described the work of the illuminating engineering department of the Denver Gas & Electric Company. The author said that the central-station illuminating engineer, after having studied the science of illuminating engineering work, learns

that his work is to "hold the business." The result is that the illuminating engineering department finds that it must sell to the same consumer light for as many hours out of the twenty-four as possible in order to widen the peak load, and that to the same consumer light must be sold for as many years as possible. Thus the peak should be widened until there is no peak and the station investment, covering mains, services, meters, etc., should be kept in actual use during the approximate life of the station installation. It is well known that the ideal load curve is one that shows no peak—it is also well known that such a load curve is almost an impossibility; there is sure to be a peak, one slope of which occurs between dusk and dawn. The study of the load curve is of great interest to the illuminating engineering department.

*Business.*—There are several classes of business to be sought, and even fought, for. One of the best is the street-lighting contract, which usually covers both the maximum hours between dusk and dawn and also covers a majority of years of the life of the plant. Another is the all-night service for advertising purposes, such as window lighting, sign lighting and billboard illumination. Another is for light over the safe in the rear of stores, etc. Another is for small lamps at the base of show windows in winter months, for the purpose of preventing the formation of frost and moisture on the windows. Another is for porch lighting on an all-night arrangement. For those customers who will not accept the all-night rate one can usually establish a 2 o'clock rate. Then there is the popular midnight lighting rate, frequently used to good advantage. There is the arc lamp for all-night use at livery-stable entrances, garage entrances, dairy stables, hospitals and any place where wagons or other vehicles leave and approach at various hours of the night. Park lighting is another good business to secure. There are also other uses for illumination at all hours of the night to which some thought might be given.

*Complaints.*—Seventy per cent of the work of the central-station illuminating engineering department is the settling of complaints of some kind or another, usually high bills. These complaints come from all departments of the company. When a complaint comes to the illuminating engineering department the illuminating engineer tags it, "Hold the business." It is the complaining consumer that is the encouraging prospective consumer for the gasoline salesman. Not many gasoline lamps would be in service to-day if all gas or electric consumers had always been pleased with and enthusiastic over the results of using either gas or electric light. The person complaining may be what is sometimes called a chronic kicker and by some departments considered incurable, but there are few chronic kickers in the Denver territory. The complaining person is usually one who complains about a high bill or poor service, or both. The first step taken is to ascertain what amount the consumer has been paying during the past year. This information is marked on the complaint memorandum for future reference; the person who turned in the complaint for the consumer is then consulted and much useful information is thus obtained. A call is then made on the consumer by a member of the illuminating engineering department, who discusses with him the reasons for his complaint. He is offered the services of the illuminating engineering department free of cost. It is explained to him that if he accepts the services of the department his place of business will be measured and a drawing of his store for illustrating a suggestion or a new system of illumination will be made.

When the consumer consents to have the illuminating engineering department measure his store and make suggestions for better illumination a drawing is made showing all of the walls, windows, doors, hallways, show windows, etc. Then if the consumer contemplates any changes in the rooms or building a note is made of them and often they are arranged for on the drawings if the changes are to be made immediately. In case there is sufficient time the openings for the lamps are so arranged that when the building is changed the proper system will be in readiness. The openings that are made in contemplation of changes are plugged and no fixtures are installed. The fixtures are specially designed or selected and specifications are drawn. The drawings and specifications are submitted to the consumer and if the plans are accepted bids are asked on the work and taken to the consumer, and the contractor is thus selected. The work of installation is superintended by the illuminating engineering department until completed and accepted by the consumer.

When the new lighting system is placed in operation the central station reaps the harvest of the work of the illuminating engineering department. No matter how bitter he may have been in his complaints, almost invariably a consumer will become very enthusiastic over the improved appearance of his store; he can then easily be induced to step outside of his store and compare the outside with the improved interior. He does not wait to be coaxed, but usually says, "What can we do about those windows and that sign?" It is not the actual amount of money the consumer pays that interests him, but how much he gets for his money. When the illuminating engineering department by a rearrangement or a new system gives him three times as much illumination as before the consumer is glad to pay the bill; the illuminating engineering department has held the business and the consumer becomes immediately a prospective consumer for better window lighting and sign advertising.

A record is kept of the work by taking a small Kodak picture of the drawing and pasting it to a reference card, which is filed for future use. The means used for keeping this record is a cabinet card showing the date, name, address, nature of business or building, installation made, style of glassware, ceiling height, color, decorations, size of room, watts per square feet, density, reasons for changing, previous installation and remarks.

A photo of the original accepted drawing is placed on this card and filed for future reference. This card is cheap and convenient to refer to later and takes little room. The consumer often wants the original drawing for other structural work, and if he so desires it is given to him, the company being released from responsibility if errors in measurements are made from the drawing, such as structural iron being short, millwork and metal ceilings not fitting, etc.

Cards are also used in keeping a record of new buildings. A record is kept of all building permits. Cards are sent to new owners, architects and contractors offering services of the illuminating engineering department.

To all representatives an opportunity is given to join an illuminating engineering class during the fall of each year, and those who join are given a series of lectures and instruction along illuminating engineering lines. They are taught to read drawings and are instructed in a few principles of fixture designing. The object of this course is to teach the commercial men the principles of illuminating engineering in order that they may correct small mistakes as they proceed in their work each day when small additions and alterations are being made. They also receive information and data regarding new shades, lamps, etc., and the uses to which they can be put.

## PRACTICAL CARE OF LEAD BATTERIES FOR VEHICLES.

Mr. S. C. Harris, of the battery department of the New York Edison Company, presented an interesting paper on the proper and practical care of vehicle batteries before the Electric Vehicle Association of America at its first convention, held in Madison Square Garden Concert Hall, New York, Oct. 18. The paper was devoted entirely to the lead cell, and before launching into his subject the author described a properly constructed battery of this type, taking up in detail the tray, manner of arranging the cells in the tray, insulation between the rows of cells, kind of contact used, quality of rubber jars, manner of assembling the cell and the style of strap used.

For sectional batteries the construction of the tray is simple

being made of wood sufficiently strong and of a size convenient to handle. For single-tray batteries stronger construction is necessary and iron must be used. There are two ways to construct these trays; one in which the iron is used to brace the heavy wooden parts and one in which the tray is made completely of iron and light wood packing is used between the cells and the tray. In the sectional batteries the cells are placed in short rows; the voltage between consecutive rows varies with the size of battery and the number of trays, but is much less than in single-tray batteries. In single-tray batteries the arrangement of cells varies with the shape of the tray. The arrangement should be such that the voltage between rows will be a minimum so as to prevent as much as possible the burning of jars if the trays and packing become acid-soaked, or if any foreign material lodges on top of the cells and becomes a good conductor through spraying or slopping of the electrolyte. The wood of the tray should not come within 1 in. of the top of the cells.

The space allowed in the tray for the cells should be enough to permit at least ¼ in. between rows. The packing between the rows should be paraffined wood and should not come within 1 in. of the tops of the cells. With the exception of the warm summer months glass sheets extending above the cells are much better than the wood packing. Glass, being a bad conductor of heat, allows the cells to become too warm in warm weather. The packing between the jars should be tight enough to prevent any movement of the jars in the tray.

Single-tray batteries have contacts on the side of the tray which engage with similar contacts on the vehicle. These contacts have not been satisfactory in many cases and have been discarded and the wires from the battery are connected to the controller wires by ordinary wire connectors. In sectional batteries this method of connection is less troublesome than that in which the contacts are placed on the trays, especially when the wood of the trays becomes acid-soaked.

Rubber jars should be of the best quality so that the troubles due to leaking jars will be reduced to a minimum. Where the conditions of operation are such that the wooden separators will have as long a life as the plates the jars should have enough sediment space to receive the sediment thrown down during the life of the positive plate.

In assembling a cell the jar should be just large enough to receive the element, which should fit so that there can be no movement of the element in the jar. The wooden separators between the plates of the element should be thick enough to prevent any movement of the plates, and should be wide enough so that they will protect the edges of the plates from any material that may lodge between and short-circuit them. The spacing between plates should be wide enough to allow sufficient acid for a complete discharge of the plate. The surfaces of the positive plate should be protected by perforated hard-rubber sheets, and the smooth side of the wooden separator should be placed against the negative plate. Strips of wood or hard rubber should be placed across the tops of the separators and securely fastened to prevent them from being misplaced. The separators should extend above the tops of the plates. The pillar strap should be used and burned low to allow considerable space between the top of the cover and the top of the jar for the slopping of acid where cells are not sealed.

With a battery constructed as above described the proper care consists in the following method of operation: Fill the cells with electrolyte of 1200 specific gravity and pass a charging current through them at a rate of 1 amp per positive plate for the M. V. size. If it is desired to complete the formation quickly a higher rate can be used if care is taken to prevent the temperature from rising beyond 100 deg. Fahr. This forming charge should be continued until the specific gravity of the electrolyte has reached its maximum and has continued at its maximum of ten hours. One cell in the battery should be used as a pilot cell on which readings are taken at regular intervals near the end of the formation. This pilot cell should have its electrolyte kept at a constant level by adding a small amount of water at frequent intervals to make up for the loss by evaporation, otherwise the readings of specific gravity will not be comparable. The specific gravity readings should also be corrected for temperature.

After the forming charge has been completed one or two discharges are taken to determine the capacity. If full capacity is not obtained it is usually due to the excessive hardness of the positive plates, in which case considerable discharging and overcharging are necessary if full capacity is desired before putting the battery in service. After the battery is put into service the following points should be carefully considered: proper charging; no over-discharging; filling cells with water of approved quality, and examining battery for leaking jars; keeping the tops of the cells free from dirt or any substance that will contaminate the electrolyte, and inspection of the battery for determining the state of charge of the individual cells.

The instructions given by the manufacturer are that the battery be charged at the normal rate until the maximum voltage is reached and then to charge at the low rate (half normal) until the same voltage is again reached. These instructions are no doubt very good if followed, but they require considerable more attention to the switchboard than is likely to be given. It is often puzzling for the attendant to know just when the maximum has been reached where several batteries of different ages are being charged at the same time. The author doubts whether the degree of accuracy in charging required for the best life of plates is obtained where this method of charging is practised.

The charging of batteries by the amp-hour meter has been tried by a number of garages with good results. By this method a certain percentage more charge is given than the discharge indicated on the dial of the amp-hour meter. The indicator of the meter is pushed forward in the direction of discharge until the meter reads the amount of charge to be put into the battery (10 per cent to 15 per cent more charge than discharge, as conditions require). The charge is then put on and the hand travels toward zero, where there is a contact which automatically opens the charging circuit when the required amp-hours have been put into the battery.

This method of charging requires much less attention at the switchboard and is more accurate than the voltage method. As a check on both the voltage and amp-hour-meter method of charging a pilot cell reading of specific gravity at the end of charge should be taken each week and when the specific gravity falls below the maximum an extended overcharge at a low rate should be given to restore the electrolyte to its maximum gravity.

The water used for filling the cells should be distilled unless it is found by examination that the water from the faucet contains no injurious impurities. When water from iron pipes is used it should be allowed to run a few minutes before using to prevent any iron scale that may be in the pipes from getting into the battery. Care should be used to avoid putting more water in each cell than is required to cover the plates about ½ in. This advice should be closely followed, as it has been found in many instances that excessive slopping has been due to overfilling with the result that the wooden trays and packing become soaked with acid, and, therefore, good conductors, causing burning of jars.

The cleaning of the tops of the cells is very important, as the dust from the street and material that is hauled in the vehicle is sometimes found in considerable quantity on the top of the battery, which, becoming saturated with acid, is another cause of burning jars. The battery compartment of the vehicle should be arranged to prevent this collection of dirt as much as possible.

The inspection of the individual cells of a battery for the purpose of determining their state of charge consists in taking voltage, specific gravity and temperature readings at regular intervals over the entire battery. The frequency with which such inspections should be made is a matter of opinion and does not affect the life of the plates materially as long as the proper

methods of operation are followed. The author said he knew of batteries that had been in service in vehicles that had not been inspected as to their state of charge for a period of four months and were found to be up to full capacity when tested. The life obtained from these plates was as good as the life obtained from plates where the voltage and gravity readings were taken weekly. A simpler and equally effective method of inspection is to observe the gassing of each cell at the end of charge once a week.

The pilot-cell readings are an indication of the condition of the whole battery and any cell that is in a sufficiently low condition to require special attention can be readily detected by slight gassing or the absence of gas at the end of charge. When the pilot cell indicates that the battery needs an overcharge to bring the specific gravity to a maximum, then voltage, specific gravity and temperature readings should be taken on all the cells.

The kind of care used in operating the vehicle has much to do with the results obtained from the battery. The route traveled by the vehicle should not be such as to require a complete discharge daily and an overdischarge should be a rare occurrence. The speed should be cut down going over rough roads to prevent the breaking of rubber jars. There is a considerable reduction in the cost per mile for running vehicles where the driver is held responsible for the condition of his vehicle and severely disciplined for carelessness in its operation.

# Wiring and Illumination

## COLORADO TOWN STREET LIGHTING.

At Fort Morgan, Col., use is made of a street-lighting scheme involving the installation of 12-ft. iron posts along the curb spaced 80 ft. apart. Each post is provided with a heavy bracket supporting two 200-watt tungsten lamps without shades at a height of about 10 ft. above the sidewalk. It is said that the effect is very pleasing, and the street is more attractive by night than by day.

## NEGLECTED CONSIDERATIONS PERTAINING TO STREET ILLUMINATION.

In a paper presented at the Baltimore convention of the Illuminating Engineering Society on Oct. 24 Mr. Preston S. Millar outlined the results of certain street-lighting tests conducted for the lamp committee of the Association of Edison Illuminating Companies and submitted some conclusions relative to the desirable features of street illumination which seem hitherto to have been overlooked.

Attention was directed to the fact that a considerable portion of the light from any lamp giving a symmetrical distribution of candle-power is lost by being directed against trees, buildings, etc. The proportion of light from various lamps effective in illuminating the street surface is about as follows:

| Lamp. | Per Cent. Light Applied 70 ft. Street. |
|---|---|
| 9.6-ampere open arc | 46 |
| 4.0-ampere magnetite, clear globe | 44 |
| 6.6-ampere magnetite, opal globe | 40 |
| 6.6-ampere enclosed arc, opal inner globe | 35 |

A symmetrical candle-power distribution is suitable for illuminating a circular area, but not for illuminating a narrow area, such as a street. To what extent it is desirable to restrict the light from the street lamps to the street surface depends upon local conditions. It may be said, however, that in general it is practicable to do much more in this direction than has been attempted without bringing about effects which are otherwise objectionable.

In discussing the uniformity of illumination over the street surface, the author described some observations made along upper Seventh Avenue, New York City. This street appears to be uniformly lighted, and yet the incident light varies largely. A test of effective brightness of the street surface showed a high degree of uniformity, thereby confirming the impression of observers. For an explanation of this remarkable state of affairs one must look to the street pavement. Examination shows that the asphalt blocks which constitute the pavement have become polished in all high spots as a result of the automobile traffic. These small polished areas reflect specularly, while the low spots of the surface which are not so polished diffuse the light more or less well. In driving through the street one sees reflected in the numerous small polished areas images or part images of distant arc lamps. The street is long, straight and lighted by arc lamps arranged in three rows. At a distance these appear to converge. The consequence is that when looking at the street surface in almost any direction required in driving a person is likely to find some one of the distant arc lamps imaged in one of the small bright areas. These are so generally distributed over the surface of the drive, and notwithstanding the rather wide spacing there are so many arc lamps which may be effective in this way, that the entire drive seems to be very uniformly illuminated.

Now, it is to be remembered that a portion of the street surface which receives the most intense light from a nearby arc lamp will reflect to the eye practically none of this light from the small brightly polished areas which reflect specularly. These appear bright only by reason of lamps located at a distance of one-fourth mile, one-half mile, or even farther away. The portions of the street surface which are not polished will reflect light more or less diffusely, and these are capable of reflecting a considerable proportion of the light toward the approaching driver. They, however, are the little valleys between the polished high spots and in many cases the high spots obstruct light which would be reflected in the direction of the approaching driver. The consequence is that in driving through Seventh Avenue, when one looks at the street surface 200 ft. or more away, he finds it bright because of the polished surfaces and the distant lamps, while when he looks downward at the nearby surface he finds it bright by reason of the diffused light when near a lamp and much less bright by reason of the same reflecting process when midway between lamps.

The author expressed the opinion that, in general, the reflecting qualities of street surface are at least as important in street lighting as are the reflecting qualities of ceiling and walls in interior illumination.

Glare has been talked of more or less in connection with street lighting for years. Recently it has come to the fore in such discussions and in consequence it seems probable that in the very near future the subject of glare will be more generally investigated than in the past. The author mentioned three effects of glare in street lighting: (1) a measurable decrease in ability to see, due to the presence of a light source in the field of vision; (2) a lessened chance of seeing a barely discernible object when viewed carelessly, even though when a careful examination of the street is made the object may be discerned just as well in spite of the glare; (3) a condition of transitory glare, due to a temporarily dazzling effect when one looks directly at a light source for moments and then looks elsewhere and finds it impossible to see well. The two last effects are difficult to measure or even to detect. The first effect may be studied without difficulty. Tests of glare in the streets as well as general observation have indicated that the distant lamps which are near the center of the field of vision are the lamps which are most harmful from the glare standpoint. Nearby lamps which are not near the center of the field of vision do relatively little damage. When the observed object is within one degree or less of a glaring source, such as a distant arc lamp, it usually is not discernible unless in the immediate region of a lamp, so that the intensity of illumina-

tion on the object is high. Thus, for example, in observing an approaching automobile in a thoroughfare like Fifth Avenue, New York, it is a common experience to be able to discern the vehicle readily without being able to see the heads and shoulders of the occupants. The distant arc lamps are absolutely prohibitive to seeing objects which are removed from them by an angle of no more than 1 deg., but the glare effect falls off so rapidly and the vision is assisted so markedly by the brightly lighted street surface that the lower portions of the vehicle may be discerned without difficulty.

There are two ways to diminish the effect of glare sufficiently to avoid harmful effects. These are: (1) Permit no exposed lamps to be located near the center of the field of vision. The author expressed the belief that satisfactory results will be achieved if no lamps can be seen within 5 deg. of the object viewed. (2) Make the effective brightness of the street high. No study of glare in the streets can lead to correct final conclusions unless it takes into account the effect upon an observer's ability to see objects when silhouetted against a lighted background.

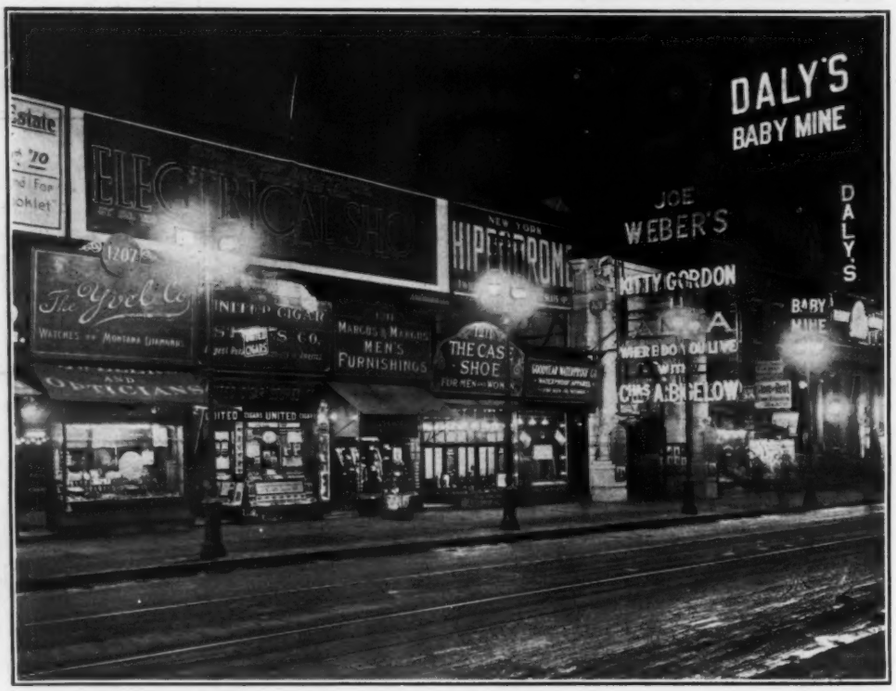
The author called attention to the outline-against-light-background method of discernment, as described in our issue for Oct. 20, and said that objects in streets at night are discerned most usually as silhouettes against a lighted background. The first requirement of good street lighting is for a well-lighted street surface to serve as a background. It is the effective brightness of street surface, or the brightness as seen when viewing the street longitudinally at an angle of from 2 deg. to 3 deg., which determines the value of the surface as a lighted background. The effective brightness may be increased by providing a greater number of more powerful lamps or by repaving the street with material having more favorable light-reflecting qualities. The light-distribution characteristics of all commercial illuminants being unsuitable for street lighting, it would appear feasible to increase the effective brightness of streets by directing a larger proportion of the light upon the street surface. With a given intensity of incident light the effective brightness of a street is greatest when the lamps are mounted over the driveway. Non-uniformity of illumination, while undesirable, is not so objectionable as has been asserted, because (1) the effective brightness of street surface does not vary as much as does the intensity of incident light, and (2) the bright street surfaces near lamps assist in discernment of large objects in the dimly lighted regions.

Glare must not be neglected. Its effect becomes harmful when the glaring source is very near (less than 5 deg. removed from) the object to be seen or when there is no lighted background against which to view objects. In ordinary city installations the glare from street lamps may dazzle temporarily after one looks directly at the lamps and may increase the chance of failure to perceive a barely perceptible object in a hasty, careless glance. But otherwise it occasions no material decrease in ability to see objects. It is entirely feasible to design a lighting installation in which there shall be entire absence of objectionable glare while securing high effective brightness of street surface. But usually in practice one must choose between decreased effective brightness of street on the one hand and some degree of glare on the other. For each such installation there is some compromise which will produce the best results. The proper compromise can be reached best not as a matter of theory or prejudgment, but as a matter of trial in the street, preferably including a determination of ability to see under the various conditions.

In concluding the author remarked that the problem of street illumination is not simple when considered alone as a matter of theory. The additional elements which commercial conditions introduce render it extremely complicated in practice. A number of the factors which enter into the problem might be studied independently with profit. But the application of the results of such studies must always be made with due regard to the importance of other factors. Our tenets of street illumination must be broad-gaged and must give proper weight to all elements of the subject, whether scientific or commercial.

## FLAMING-ARC LAMPS IN NEW YORK'S THEATRICAL DISTRICT.

As is probably well known, New York City's "Great White Way" is so well lighted by electric signs, windows, etc., that the arc lamps of the city would not be missed if they were extinguished, so feeble are their rays when compared with the light paid for by private interests. In order to attract attention, therefore, nothing short of flaming-arc lamps will serve in districts already ablaze. Many merchants recognize this fact and have made the Rialto much brighter by the installation of flaming arcs, which in turn necessitated a lavish use of tungstens in windows to counteract the effect of the dimness which obtained there. The accompanying illustration shows a flaming-arc installation on Broadway at Twenty-ninth Street in front of Weber's Theater. Four Mott Iron Works regulation city poles are spaced about 30 ft. apart and support eight Grant flaming-arc lamps. In order to distinguish the poles from those of the city they are finished in bronze. The lamps burn two in series across the 110-volt, direct-current mains of the New York Edison Company, each pair consuming 10 amp. Impregnated electrodes giving a yellow light are used, and the lamps are trimmed after every eighteen hours of burning. Instead of




Installation of Flaming Arcs at Broadway and Twenty-ninth Street, New York.

being arranged at right angles to the street, the lamps are hung parallel to the sidewalk so as to give the maximum amount of light on the sidewalk. In addition to the eight lamps on the posts there are two others hung on either side of the theater entrance. The brilliancy of the lighting is well shown in the engraving, and its effect has been to increase the traffic of promenaders on a street already crowded as much at night as it is during the day.

## ILLUMINATION AT THE DENVER ELECTRIC SHOW.

BY JOSEPH A. MCMEEL.

As published in these columns on Oct. 13, the first annual electric show of the Colorado Electric Club, an organization composed of the electric interests of Colorado, opened in the Auditorium, Denver, on the evening of Oct. 8, and continued through the week to Oct. 15. This exposition, which was in reality a celebration of the progress made in the electrical industry in the West, was characterized by the most spectacular

Fig. 1—General View of Denver Electric Show, Showing Spectacular Sunrise Effect in Background.

street-lighting features ever seen in Denver. The streets leading to the Auditorium were one profusion of dazzling light, and over 100,000 of the city's population turned out on the opening night to view the monster illuminating features. The congestion of traffic was the worst the police of Denver ever handled. As already published, at 7:30 o'clock on the evening of Oct. 8 Captain Wm. H. Green, accompanied by Governor Shafroth, stepped on the platform erected on the Fourteenth Street side of the Auditorium to push the button that flooded the great hall with light. Simultaneously every whistle, bell and gun in the vicinity was turned loose to send broadcast the message that the first lighting festival of the West had opened in Denver. Inscribed on the button were the words, "And God said: Let there be light."

The street illumination during the week excelled that at the recent Mardi Gras celebration at New Orleans, which was conceded to be a revelation, and was on a par with some of the creations that electrified New York City at the Hudson-Fulton celebration last fall. Champa and Curtis Streets, the thoroughfares leading to the Auditorium, were decorated with a portière and stringer effect. Franklin's kite portrayed in light soared above the highest building on Curtis Street and was considered a remarkable piece, as was the Liberty Bell on Champa Street. Denver's "Great White Way," Sixteenth Street, seemed to grow dim before the luster of the decorations.

Directly after the streets were illuminated there was a rush for the great amphitheater where the show was being held. For hours the entrance was blocked by people waiting to secure tickets. The attendance on opening night was estimated to be in the neighborhood of 15,000, while each day thereafter averaged about 4000.

Demonstrations of electrically operated mining machinery were made to show how the industry has been revolutionized in the last decade. The advent of electric energy into isolated regions where the cost of fuel was a detriment to operations has established a new era in the mining industry. Many properties, some of which have remained idle since the Territorial days of Colorado, have resumed operations through the introduction of electric energy into the districts. These displays proved to be of a strictly educational nature and many mining men interested in a low cost of production received sufficient evidence of the value of electricity for their purposes. The Northern Colorado Power Company and the Central Colorado Power Company co-operated with the Hendrie & Bolthoff Manufacturing & Supply Company, of Denver, in giving these demonstrations.

The agricultural industry of Colorado contributes most to its prosperity. There is a wealth of uncultivated arid land throughout the State, 80,000 acres of which have been reclaimed and put under cultivation through the agency of the electric pump. At one time a dry farming rage was on in the State, but this movement has sunk into comparative oblivion. The culti-

vated area is being rapidly increased by means of electric pumping, which was thoroughly exploited during the show.

The Denver Gas & Electric Company's exhibit of a modern electric home was one of the most interesting. Every conceivable appliance used in curtailing the work of the housewife

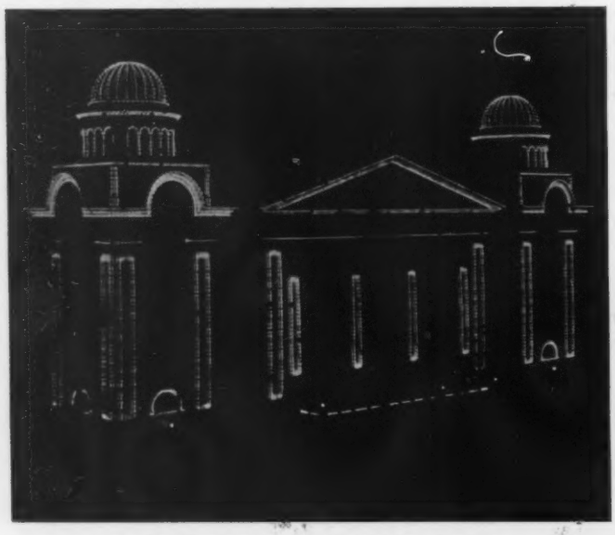


Fig. 2—Illumination of Auditorium Exterior.

in the home was displayed. The small electric disk stove and the elaborate electric piano each had its station. The contrast of the clean, silent and cool electric kitchen with the smoky, mussy and hot one was well set forth.

The Pike's Peak sunrise depiction was the most wonderful production of scenic illumination ever witnessed by Denver people. It was portrayed with a certain amount of realism that attracted and charmed those who viewed it. Three thousand lamps were used, 2500 for the sun, while a sufficient number were employed in bringing out the ray effect.

In the basement of the Auditorium was located the "Chamber of Wonders." Here all the freakish whims of electricity were

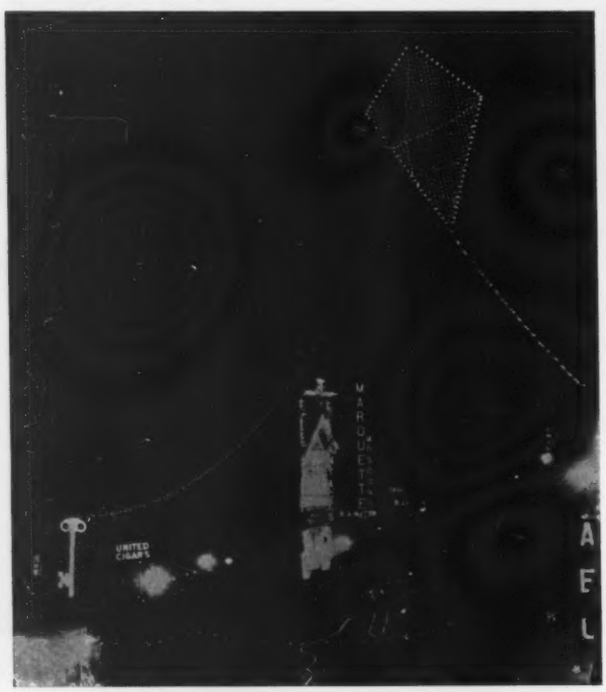


Fig. 3—Electric Kite on Curtis Street.

displayed. The principal feature was a specially designed apparatus demonstrating interesting high-frequency experiments. This apparatus consisted of an oil-immersed transformer with a primary winding, taking 440-volt, 60-cycle current, the secondary being wound for 150,000 volts. This circuit was connected to the primary of a Tesla coil through the medium of large 40-plate glass condensers and multiple spark gap oscillator, which produced, at the secondary terminals of the Tesla coil, upwards of 1,000,000 volts.

The phenomena of high voltage and high frequency were exhibited on various pieces of apparatus, showing the disruptive power, through the piercing of glass plates, brush discharge, climbing arc, illuminating of Geissler tubes and vacuum electrodes, imitation of thunder and lightning, the lighting of incandescent lamps held in the hand without wire connections and the passing of 1,000,000 volts through the body of the operator and various other spectacular demonstrations. These displays were conducted by Mr. W. P. Carstarphen, Jr.

A scholarship prize contest for boys was held in connection

Fig. 4—View of Champa Street During Electric Show.

with the show. About forty young Edisons and Thomsons of Denver were interested in this contest. The equipment entered consisted mostly of wireless telegraph instruments and models of aeroplanes. In the finals five boys were awarded prizes for exhibitions of wireless telegraph instruments and one aeroplane exhibitor was successful in landing a prize.

The Colorado Electric Club has definitely decided to hold electric shows annually in Denver. Next year it is planned to make the street illuminating features even more elaborate, and such effects as the mountain sunrise will be attempted on a broader scale.

## RATES FOR ELECTRIC VEHICLE CHARGING IN MILWAUKEE.

Owners of electric vehicles in Milwaukee may take advantage of the favorable "ten-seven" rate offered by the Milwaukee Electric Railway & Light Company, under which the customary demand charge is reduced by three-quarters, making the equivalent rate from 5 cents to 1½ cents per kw-hour, depending upon the quantity used. The taking of energy under this rate is limited to the after-peak hours between 10 p. m. and 7 a. m.

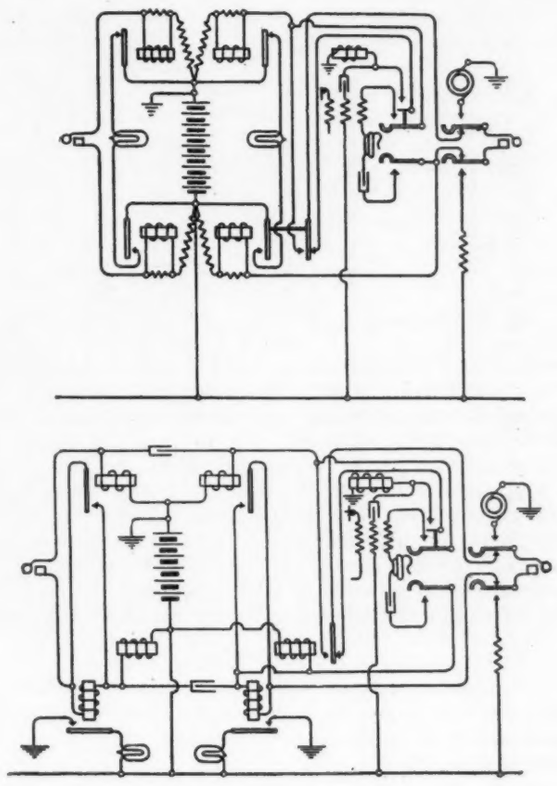
## FIVE MILES OF DECORATIVE STREET LIGHTING IN CHICAGO.

From Desplaines Street to Fifty-first Avenue, throughout five miles of its length, West Madison Street, Chicago, was the scene of a street carnival during the week of Oct. 17. The affair was heartily participated in by the merchants whose stores line this great artery of Chicago's West Side, and special events, automobile parades, etc., were held each evening. A feature of the carnival was the electrical decorations, festoons of forty 8-cp lamps, caught up at the center, spanning the street at half-block intervals throughout the entire participating length of the street.

## RECENT TELEPHONE PATENTS.

### SWITCHBOARD CIRCUITS.

Mr. C. S. Winston, of Chicago, has patented two switchboard-circuit systems of the two-wire, common-battery type, both patents being assigned to the Kellogg Switchboard & Supply Company. The novelty in both cases seems to lie in the cord signaling circuits. In one of the circuits a repeating coil is used with the battery supply cut in at its middle. Two



Switchboard Circuit Systems.

relays are used for each cord, one in each strand. One is a cut-on relay in the strand which feeds the cut-off relay and the other a cut-on relay in the strand feeding the line directly. The second system uses a retardation coil feed, relays serving the line strand of each cord and retardation coils the other strand. In the cut-off relay strand there are series relays which close the lamp circuit, except when shunted out by the contacts of the line strand relays, which follow the station hook switch. Fig. 1 shows both cord circuits.

### PARTY-LINE SYSTEMS.

A lock-out system is described in Mr. H. G. Webster's patent, which party-line system is for use with common-battery lines. A limit relay at each station is shunted out by the transmitter circuit of its own or any other station of the line. To this end, the relay windings, connected across the line are made of high resistance compared with that of the transmitter circuit, also across the line. When the limit relay fails at any station that station is locked off the line. If a second station is desired upon any line, the transmitter bridge at the calling station must be opened by a manual key until the desired station has responded. The patent is assigned to the Kellogg Switchboard & Supply Company.

In a system patented by Mr. W. F. Mikolasek, of Scotland, S. D., the connection of an undesired station to the line during conversation is evidenced by the operation of a buzzer

Mr. C. T. Patterson, of Albany, Ore., has a step-by-step system. Energy is furnished on the main line from a main-line battery. The stepping motor at each station drives an insulating cylinder carrying contact bars. The angular motion of the cylinder about its axis determines the connection of the various stations.

With multi-station lines the habit of listening-in with a consequent running down of the batteries has led Mr. W. E. Burt, of Yuba, Wis., to devise a hook-switch retainer for mounting upon wall sets. This retainer permits the hook-switch lever to rise half way and there stop. The contacts are so arranged that this mid position corresponds to a closure of the receiver circuit, but not to a closure of the battery circuit. For talking connection the stop is pulled back to permit full travel of the switch lever.

### NEW APPARATUS.

A hand microphone set forms the subject of a patent granted to Mr. J. N. Wallace, of La Crosse, Wis., and assigned to the Vote-Berger Company. The handle consists of a split tube, the two halves of which, after being abutted, are held by end ferrules and a middle sleeve serving as a hand grip. The receiver and transmitter are secured to their respective ends, but taper bushings are inserted between them and the handle to give the transmitter and receiver a tilt to suit more readily the average head.

A patent granted to Mr. R. J. Barber, of Belmont, Mass., and assigned to the Globe Earphone Company describes a means of adjusting receivers used to assist the deaf to hear. It is necessary to provide an adjustment suitable for unskilled hands. The diaphragm is secured within the earpiece. This latter is threaded and arranged to screw down over the receiver body. A lock nut or ring upon the body ahead of the cap serves to lock the cap where placed. A stop is provided so that the cap may not advance further than the position corresponding to minimum allowable clearance between the diaphragm and pole pieces.

Another patent assigned to the Vote-Berger Company is that issued to Mr. H. S. Mattison, of La Crosse, Wis., for a transmitter. The diaphragm has a peripheral groove which receives a resilient gasket of circular section. This gasket lies only partly in the groove and serves to hold the diaphragm clear of the transmitter casing. A spider-like spring member perforated to receive the microphone button at its middle bears upon the diaphragm to hold it down to the casing.

Mr. W. E. Harkness, of East Orange, N. J., has obtained a reissue of a patent for a telephone transmitter of the inverted, solid-back type. The patent covers the seating of the microphone button casing in a central aperture of the transmitter diaphragm so as to vibrate with the diaphragm. The reissued patent is assigned to the Dean Electric Company.

A patent granted to Mr. O. F. Falk, of Belleville, N. J., describes a special mouthpiece for transmitters as applied to the so-called "Dictograph." The mouthpiece is conical, with its wide end outward. Another cone of sheet metal of lesser altitude is mounted within the first one, with its apex outward. An annular space is left between the base of this cone and the mouthpiece wall. It will be seen that sound impinging on the mouthpiece and cone will be deflected through the annular space and that behind the cone all reflections ultimately turn the sound toward the diaphragm. This patent is assigned to the National Dictograph Company.

# Letters to the Editor.

## The Light of the Firefly.

*To the Editor of Electrical World:*

Sir:—Your editorial comments on "The Light of the Firefly," page 846 of your issue of Oct. 13, interested me very much. It is certainly gratifying to have the rigid scientific evidence furnished by Ives and Coblentz that the light of the firefly is really light alone, unadulterated by wasteful radiation. This we have long suspected, and some of us have assumed it to be true on the basis of evolution—the survival of those fireflies and their progeny which could give the greatest light output for the least expenditure of energy. The light here referred to is, of course, physiological light, wave lengths which most strongly affect the retina. Incidentally it may be pointed out that the fiber of silk is very much stronger, weight for weight, than any metallic wire; and that the same is true of many animal and vegetable fibers, particularly the former. Again, the greatest perfection will have been reached, in the evolutionary process of elimination of the less fit, in that organism which, other things being the same, has been under stress longest and of which the number of generations has been greatest. Hence, those forms which were on the earth early and which reach maturity quickly have become almost perfectly fitted to their conditions of life. Witness the complete, though from our standpoint undesirable, social system of the ants, the bees and the wasps.

It is probably true, as a result of evolution, that the sensitiveness of retinas of different animal organisms varies much as regards amplitude of what we call light waves, and also in relation to varied wave lengths. That creature which has been under the necessity of distinguishing colors most definitely and acutely will naturally have the sharpest color vision for such wave lengths as concern it the more particularly; and that creature which has the need of the widest range in this respect will probably be man. It is even asserted that some of the lower races of men are devoid of an acute sense of the violet rays of the spectrum, and it is known that even among civilized men wide variations in color sense occur. This may possibly be due to atavistic tendencies, and to an assumed late development of the color sense.

The question has often been asked, Why do we see only such a limited range of wave lengths, when radiation of waves of the character of light may extend far beyond the violet in the ultra-violet, and far below the red in the infra-red? I have never heard or read of an appropriate answer, but I think I can contribute to the solution of the question, and also make it fairly clear why for most seeing animals the visible radiations are within our own visible spectrum range. In the first place, what we know as transparent bodies are more or less opaque to ultra-violet. Prof. R. W. Wood has shown that bodies which reflect or diffuse the rays of ordinary light, and even appear white, may absorb ultra-violet, and would be, so to speak, black if seen by ultra-violet light, supposing we could suddenly acquire a power of vision which would include such light.

Again, the infra-red can penetrate bodies ordinarily black, and a vision including them involves similar contradictory impressions. The sky would be dark, and foliage nearly white, as the photographs of Professor Wood show. From these considerations it is evident that a sense of vision including ultra-violet and infra-red would tend more to obscure than assist visibility of objects illuminated by a wide range of radiation.

Moreover, distinctness of vision or optical resolving power for fine details is an inverse function of wave length. This means that if vision were alone possible with rays far below the red the fine edges of objects would become blurred and indistinct; while, what is more important, if our vision by ordinary light were to have superposed on it vision by such low waves, the result would be, not to sharpen vision, but to confuse the outlines of objects or blur the fine details.

*West Lynn, Mass.* Elihu Thomson.

*To the Editor of Electrical World:*

Sir:—With reference to the interesting results published by Dr. Ives in your issue of Oct. 13 the following observations on the transparency of various parts of the outer covering of the firefly may be helpful in indicating in what spectral region one may expect to find possible radiations if generated within the body of the firefly and transmitted through the outer integument.

The part examined is the outer integument, called "chitin," which is an amorphous, horny substance varying in color from white (covering over the luminous organs) to a dark brown. The latter color, as will be noticed in the present illustrations, is simply due to a pigment which absorbs heavily in the visible spectrum—see curve *a*, Fig. 1.

The determination of the transmissivity is very difficult on account of the smallness of the specimens and their lack of homogeneity. In the present examination the specimens were mounted upon a thick cardboard with a suitable opening in it and placed over the spectrometer slit. An image of a well-seasoned Nernst glower was projected thereon, and its spectral energy curve was observed. Subsequently the specimen was removed from the cardboard and the spectral radiation curve of the glower was obtained. The ratio of the emissivities (bolometer-galvanometer deflections) gives the transmission at any wave length. By operating the glower on a storage battery it was possible to keep its temperature constant to a much higher precision than was required in the experiment.

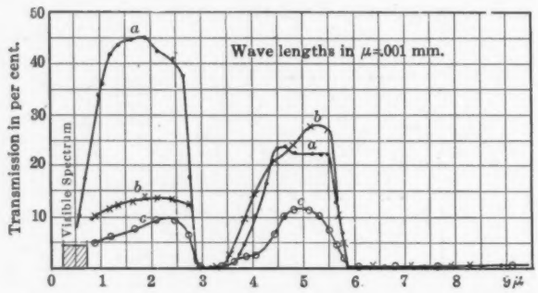



Fig. 1—Transmissivity of Various Members of a Firefly.

In Fig. 1 curve *a* gives the transmission through one of the horny abdominal segments of a dried specimen of the Cuban firefly, Pyrophorus noctilucus. This integument is dark brown (in reflected light), which causes a heavy absorption through the visible spectrum to the red, at which point the transmission increases rapidly. In this firefly, it may be recalled, the abdominal light is emitted through a slit between two of the segments, of which the above is a sample. The size of the segment examined was about 1.5 mm x 7 mm. In this same illustration, Fig. 1, curve *b* gives the transmission through one of the eye-like, fenestrate membranes on the thorax of the Cuban firefly, through which is emitted the so-called "thoracic light." The specimen was only 1.5 mm x 2 mm and hence very difficult to examine. After removing all the photogenic cell ligaments which adhered to it this specimen was fairly translucent. In the region from 1 μ to 2 μ (μ = 0.001 mm) the transmissivity is probably higher than observed, the low values being due to scattering of the radiation in passing through the specimen.

Curve *c*, Fig. 1, gives the transmission through the outer integument covering the photogenic cells of Photinus pyralis. The specimen examined was a single dried abdominal segment 1:5 mm x 4 mm, which had been moistened in water and freed from all ligaments and photogenic material. The specimen was not very smooth and it was only semi-translucent. No doubt

a better sample could have been prepared by dissecting a fresh undried insect. In both curves *b* and *c* the opacity at 1 $\mu$ to 2 $\mu$ and at 5 $\mu$ is greatly increased by scattering of the transmitted radiation which did not reach the bolometer. However, as was anticipated in a previous communication, these curves have the characteristic absorption spectrum of complex carbohydrates, in which there is great (and usually complete) opacity from 2.8 $\mu$ to 3.8 $\mu$, and beyond 6 $\mu$, with a fairly transparent region at 4.5 $\mu$ to 5 $\mu$.

It may be noticed that these specimens were dry. If they had been fresh, then the water would have absorbed most of the radiation at 4 $\mu$ to 5 $\mu$, as may be noticed in Fig. 2, curve *b*, which gives the transmissivity of a layer of water only 0.038 mm thick. Curve *c* gives the transmission of a layer of water 0.31 mm in thickness which shows complete opacity beyond 2.5 $\mu$.

Now, the photogenic cells are not directly in contact with the outer integument (at least the most of them are not so situated), so that there can easily be an intervening layer of water molecules equivalent to 0.1 mm in thickness. If we superpose the curves in Figs. 1 and 2 we can see that only an extremely small amount, if any, of the radiation of wave-lengths greater than 2.5 $\mu$ (assuming that such radiations are generated within the photogenic cells) can pass out into space. The experiments of Ives bridged the gap from the visible to 1.5 $\mu$. The present data show that but little radiant energy (if generated

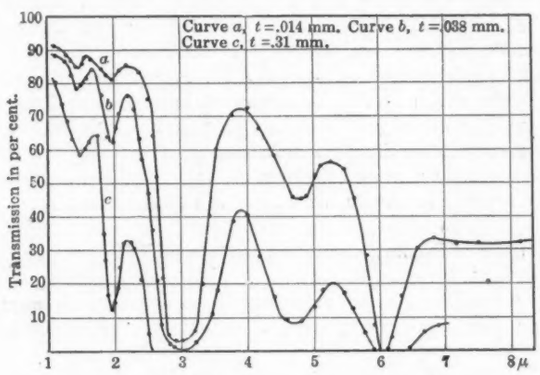



**Fig. 2—Transmissivity in Presence of Moisture.**

in the photogenic cells) of wave lengths greater than 2.5 $\mu$ will get out of the insect's body. That which does get out at 4 $\mu$ to 5 $\mu$ will be so weak in intensity that it will hardly be distinguishable from the emission spectrum of the "animal heat," radiated from the surface of the body, which has its maximum in the region of 7 $\mu$. By exclusion we have therefore reduced the unexplored region to that part of the spectrum lying between the wave lengths 1.5 $\mu$ and 2.5 $\mu$. There are no types of radiators known which would lead one to expect emission bands in this region of the spectrum of the light from the firefly and while it is important to be on the alert for the unexpected it seems just as probable that the explanation will be found in biochemical phenomena not requiring the production of radiations of low frequency in order to produce a given amount of light.

Numerous illustrations have recently been published[1] showing that in incandescent solids and in gases excited in vacuum tubes the production of light is accompanied by a very considerable production of infra-red radiation; that the arc light, especially the "flaming-arc" lamp, is the most efficient because of the absence of an appreciable amount of infra-red radiation, and finally, that in the high-frequency spark nearly all the radiation is in the ultra-violet (and hence useless to man) with but little if any radiation in the infra-red. In this classification the firefly would have to be compared with the flaming arc, which seems absurd.

Finally, it may be added that in determining the *radiant* efficiency of the firefly the assumptions made by Ives and Coblentz, of no appreciable amount of infra-red radiation, seem to be sustained by their subsequent experiments.

The experiments of Ives confirm the results obtained in this laboratory the preceding summer that keeping the insect in the dark, dead or alive, heating or cooling it, or exposing it to ultra-violet light, gives no indication that the light is of a fluorescent nature. These experiments were confirmed again this summer when various species of fireflies were kept in the dark for several days. The receptacles were of such a nature that the health of the insect was not impaired. The main point of interest was that in the dark they kept up their usual flashing, which was immediately stopped when exposed to light.

This test was applied repeatedly in rapid succession with the same results. The propensity of the firefly to flash in the dark is not unlike that of a hen going to roost during a total eclipse of the sun. These tests, of course, are nothing more than have been made by others during the past fifty years, when the insect has been subjected to all sorts of indignities to wrest its secret from it, but all in vain. Perhaps when we learn something about triboluminescence and the phosphorescence in marine animals due to the contraction of the muscular fibers the phenomenon may become clearer. In this connection the time seems opportune for us to discard our old habit of expecting the production of "light" to be accompanied by the production of a very appreciable amount of radiation (especially in the infra-red) not affecting the eye.

The question of the composition of the light emitted by various species of fireflies is of considerable interest. The species Photinus pyralis, studied by Dr. Ives and myself a year ago, emits a rich yellowish light extending well into the red. Another species, Photuris pennsylvanica, emits a much brighter flash of shorter duration and of a much more greenish hue than the longer and more frequent fulmination of the Photinus. The emission band does not seem so broad as in the latter species. Spectral photographs were obtained this summer to determine (1) whether the maximum of the emission band of light from the Photuris lies at the same point as the one found (at 0.57 $\mu$) in the light of the Photinus, the side of the energy curve, toward the red, being simply steeper, due to a deficiency of radiation in the yellow and red; (2) whether the maximum actually lies farther toward the green, as the bluish-green flash seems to indicate, or (3) whether the bluish-green color is simply a matter of comparison with other light. In this connection it may be added, in parentheses, that with both species in a glass vessel for comparison the light from the Photuris appeared the more bluish green when in a perfectly dark room, while there seemed to be no difference in color when these two species emitted light near a carbon-incandescent lamp. Unfortunately, the photographic plates at hand were not sufficiently sensitive and the photographs obtained were never thoroughly examined photometrically. Furthermore, the Photuris came earlier in the season than had been anticipated and in the course of only a few days after starting the work this particular species had entirely disappeared. The work was, therefore, discontinued until next summer. From the data at hand it appears that the light from the Photuris pennsylvanica consists of a narrower and much more intense band than that emitted by the Photinus pyralis, due to a greater deficiency of yellow and red light; i.e., it is more nearly monochromatic. Whether the maximum emission is very different in these two genera is not definitely determined. Until we can get further data it is an interesting speculation whether in the Photuris the apparent loss in breadth of spectrum is compensated by a greater intensity at the point of maximum emission. In other words, what are the relative areas of the spectral energy curves of the light emitted by these two genera of fireflies? In this connection it is to be remembered that in the Photinus pyralis the flash is more frequent and of longer duration than in the Photuris pennsylvanica.

*Bureau of Standards,* W. W. COBLENTZ.
*Washington, D. C.*

[1] Coblentz, *Illuminating Engineer*, London, Vol. III, 1910.

# Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

## Generators, Motors and Transformers.

*Leakage Reactance.*—J. Rezelman.—A mathematical paper in which, from the test results on various machines, the author deduces a method for estimating the mutual induction between the overhanging coils of the different phases of a stator winding. Following this he proceeds to estimate the negative mutual induction between the overhanging coils of the stator and rotor of a non-synchronous motor. The article is illustrated by diagrams, and numerical examples are given.—Lond. *Electrician,* Oct. 7.

*Brussels Exposition.*—J. Reyval.—An illustrated description of various exhibits at the Brussels Exposition, especially of dynamo-electric machinery. Among them is a turbo-alternator giving 1500 kw at 10,000 volts and 50 cycles, compounded according to the system of Latour; also a water pump driven by a three-phase commutator motor the speed of which is regulated by displacement of the brushes. The stator and the rotor of the machine are connected in series. This is, however, not the most general case. Often the two windings are connected through a transformer so as to change the voltage. The introduction of an air-gap in this transformer limits the speed of the motor.—*La Lumière Elec.,* Oct. 1.

*Vertical Alternators.*—L. Legros.—An illustrated article on vertical low-speed alternators. Some details of construction of such alternators built by the Oerlikon Company are given with test results.—*Elek. Zeit.,* Oct. 6.

*Noise of Electrical Machines.*—E. Schulz.—A discussion of the different causes of noise made by electrical machines, with special reference to the effect of the form of the slots and the air-gap.—*Elek. Anz.,* Sept. 29.

## Lamps and Lighting.

*Metallic-Filament Lamps.*—B. Duschnitz.—The author gives a review of various new processes for making metallic-filament lamps; in some of these processes use is made of an organic substance as binding material. To produce a very finely divided tungsten powder which is specially suited for the manufacture of filaments E. Ruhstrat uses the following process: Ordinary tungsten powder is dropped through an arc lighted in a hydrogen or nitrogen atmosphere or in a vacuum and the thus superheated powder is then subjected to a sudden cooling by catching it in a cool reservoir or in a liquid. The tungsten particles are thereby rendered very brittle and can be diminuted to an exceedingly fine powder, which almost approaches the colloidal state. The Allge. Elek. Ges. has obtained filaments consisting of a mixture of conductors of the first and second class. Refractory materials like titanium and tungsten are mixed with carbon and silicon and are melted to produce a mixture of titanium or tungsten with silicon carbide. The properties of such a filament depend on the proportion in which the two constituents are present. To get a long life it is important to select such a proportion of the two constituents that the electric resistivity of the finished filament has a positive temperature-resistance coefficient. The best proportion seems to be to mix the two constituents in the ratio of their equivalent weights. Lamps containing such a filament do not need to be evacuated to a very high vacuum with a pump. If a partial vacuum has been produced the globe is closed and the filament is then heated for a short time by the electric current to a very high temperature. A chemical reaction between the residue of gases, such as nitrogen and oxygen, with the metal takes place. Nitrites, etc., are produced and a perfect vacuum is obtained. At the same time it is claimed that the filament, which was formerly dark, is now covered with a very thin layer of high emissivity whereby the efficiency of the lamp is greatly increased.—*Elek. Anz.,* Sept. 22.

*Three-Phase Arc Lamp with Four Electrodes.*—A. Righi.—An abstract of a paper presented before the Italian Electrical Association. The arrangement of electrodes is as follows: The three bottom electrodes, 8 mm in diameter, connected to each phase and adapted for fixing in the ordinary holder of a single-phase lamp, are set vertically, so that they form the edges of a triangular prism, the side of which measures from 14 mm to 15 mm. The fourth electrode, about 25 mm in diameter, is set above them coaxially with the prism, and is suspended in such a manner that it can deviate slightly from the vertical so as to enable it to make simultaneous contact with the three bottom electrodes. In this way three star-connected arcs are formed with the production of six craters, which are the main sources of luminosity in the lamp. Owing to the position of the three top craters the light is in great part thrown downward without the necessity for using reflectors such as single-phase lamps require. The supply pressure can be adjusted either by impedances or by transformers, mesh or star wound. In the latter case the fourth electrode can be connected to the center point of the star. In the regulating mechanism the series coil carries the current of one phase, while the shunt coil may be connected between the fourth electrode and any one phase, or between two phases. When the arcs are started between the three electrodes the fourth electrode, which at first is supported quite clear of them, is gradually lowered until it forms part of the path of the arcs and three craters are then developed in it. During the movement there is not much change in the value of the current or the light emitted, but when the craters are once formed there is a marked diminution of the current, and the light, which, to begin with, was fluctuating and badly distributed, undergoes a substantial increase and gives a distribution which is well suited for illuminating purposes. It is expected frequencies lower even than 17 cycles per second can be used.—Lond. *Electrician,* Oct. 7.

*The Eye as an Electric Organ.*—W. M. Thornton.—The author first considers the influence of absorption on vision. The greater part of the incident energy is absorbed before reaching the vitreous humor, but the rate of diminution in the latter is so great that in the case of exposure to very strong light injury is lessened. The chief function of the vitreous humor, from this point of view, is to act as an absorbing screen protecting the retina from possible over-exposure. Although absorption would appear to reduce the sensitiveness of the eye by its presence the structure of the retina can by it be much more delicate without risk of injury. The least electrical current in a nerve fiber which can produce the sensation of light is about $2.87 \times 10^{-14}$ amp. If this is correct the eye would appear to be able to detect about one-twentieth of the energy required for the least perception of sound. The current, when viewing white clouds in full sunlight with one's back to the sun, is about $7.0 \times 10^{-12}$ amp in the fibers.—*Phil. Mag.,* October.

*Sterilization of Water by Ultra-Violet Light.*—V. Henri, A. Helbronner and M. de Recklinghausen.—A note on a paper presented before the French Academy of Sciences. Systematic tests have shown that the sterilization of large quantities of water by ultra-violet light can be obtained at a maximum expense of 36 watt-hours per cubic meter.—*La Lumière Elec.,* Oct. 1.

## Generation, Transmission and Distribution.

*Variable-Speed Three-Phase Motors.*—J. J. E. Schuurman.—An Iron and Steel Institute paper on the use of three-phase motors with variable speed in steel mills. After a brief discussion of the wasteful nature of speed regulation of induction motors by inserting resistance in the secondary circuit, and

the disadvantage of this method of regulation that for a once-adjusted slip resistance the speed changes to a very great extent with variations of the load and rises to practically its normal value at no load, the author described the system of regulation of A. Scherbius. In this system, instead of the slip-rings being connected to a variable resistance, they are connected to an auxiliary motor (Fig. 1) of the three-phase commutator type, so that the energy can be utilized. The auxiliary motor is shunt-excited, and, possessing little inductance, can be regarded practically as running like a continuous-current machine. Speed regulation of the main motor is obtained by adjustment of the excitation of the auxiliary motor, and thus controlling the motor voltage. A compound winding on the auxiliary motor can produce a drop of speed of the main

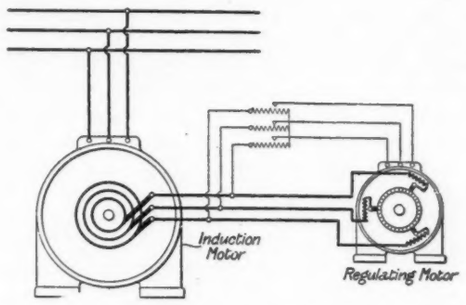



Fig. 1—The Scherbius System of Speed Regulation.

motor, so that the energy of a flywheel may be drawn upon automatically if required. The auxiliary motor can either be coupled directly to the main motor, so that the slip energy is given back mechanically to the main driving shaft, or it can drive an induction generator and return energy electrically to the line. In general, the former arrangement is the more desirable, but it is not always possible, as with it the regulating motor must follow the speed fluctuations of the main motor, and on this account becomes too expensive for very wide ranges of regulation. In such cases the regulating set, which runs at constant speed, is preferable. Another point

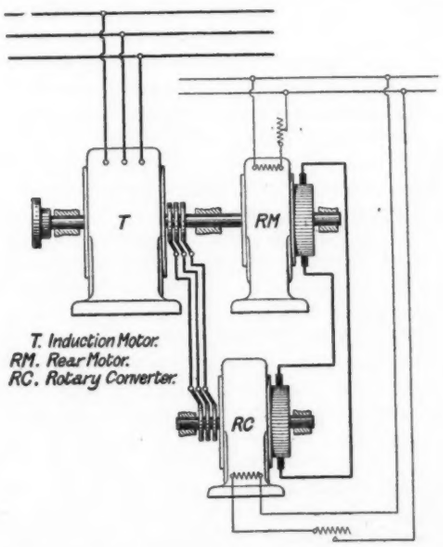



Fig. 2—The Krämer System of Speed Regulation.

about the Scherbius system is that it can be used to obtain speeds above as well as below synchronous speed. It also permits of the power-factor compensation. The system due to C. Krämer was then described. In this case (Fig. 2) the slip energy is converted by a rotary converter to continuous current, which is fed to the continuous-current motor assisting the main motor, and the speed is regulated by varying the resistance in the shunt-field circuit of the auxiliary motor. When resistance is cut out the armature voltage and the continuous-current voltage of the rotary converter will increase. At the same time the alternating-current voltage at the slip-rings must increase, as the continuous-current and alternating-current voltage of a rotary converter stand in a fixed relation to each other. The speed of the main motor will thus decrease. The system is capable of very wide ranges of regulation, but it is rather more complicated than the Scherbius system; moreover, it cannot be used so easily with existing motors. The Déri single-phase repulsion motor offers a third solution of the problem, particularly in the matter of output. It is shown diagrammatically in Fig. 3. The speed regulation and reversal are effected entirely by alternation of the position of the movable brushes. The motor has a series characteristic or, more exactly, an infinite number of such characteristics, each being for a certain position of the brushes, as shown in the diagram. By moving back the brushes over the zero position during running regenerative control can be obtained. The first advantage of the Déri motor is its simplicity. When the output is small the single-phase Déri motor will hardly affect the distribution of the load on the three phases of a system, especially when there are several such motors which can be divided over the different phases. But when large motor outputs come into question it is better to make use of a double-commutator motor, which electrically consists of two Déri motors mechanically built into one. Examples are mentioned in the paper of motors up to 2000 hp controlled by the Scherbius system. The Krämer system is also used in a few rolling mills. Déri double-commutator motors of 250 hp are

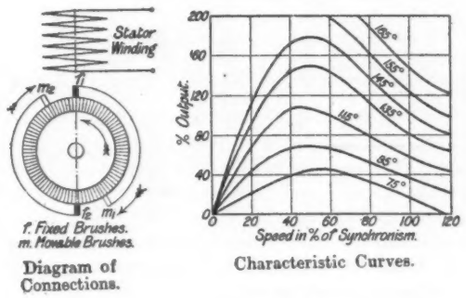



Fig. 3—The Déri Variable-Speed Single-Phase Motor.

under construction for a corrugated tube mill in Germany. The Déri motor is also suitable for cranes and other auxiliary machinery.—Lond. *Elec. Eng'ing,* Oct. 6.

*Voltage Regulation.*—A note on a recent British patent (23,416, Sept. 29, 1910) of the British Thomson-Houston Company (General Electric Company of this country). In order to produce a compounding effect in alternating-current circuits two transformers are connected with their primaries in series with each other and in shunt to the supply, and their secondaries in series with each other and with the load. One transformer has a saturated and the other an unsaturated core, and the relative connections are reversed so that the secondary voltages are in opposition. At no load the voltages are equal and opposite, but as the load increases the magnetization of the unsaturated transformer is increased. This increases its voltage and thus raises the main voltage.—Lond. *Elec. Eng'ing,* Oct. 6.

*Italian Water-Power Station.*—J. COLLIGNON.—An illustrated description of the Cervara water-power station in Italy. It contains five three-phase alternators, each of 1900 kw, coupled to 2200-hp water turbines. The plant supplies electricity at 3750 volts (which is the generating voltage) to the City of Terni, and also supplies a large amount to a calcium carbide plant in Narni, the transmission e.m.f. being 27,000 volts.—*La Houille Blanche,* September.

*Lifting Magnets.*—J. LISKA.—A mathematical paper illustrated by diagrams in which the author gives the general formula for the tractive force of alternating-current magnets as a function of the air-gap, taking into account the stray flux

and the ohmic resistance. The heating of the magnets is then discussed, and an example from practice is given.—*Elek. Zeit.*, Sept. 29 and Oct. 6.

### Installations, Systems and Appliances.

*Present Condition of Electrical Industries in Germany.*—G. Dettmar.—A lecture held at the World's Fair in Brussels. There are at present 150,000 working men and employees in the German electrical industries. The value of their products is $250,000,000 and is the highest of all the countries of the world; one-fourth by value of the products is exported. The progress made in machine construction is indicated in the gradual reduction of weight of a 10-hp, 1000-r.p.m., direct-current motor, as shown in Fig. 4. The weight was 900 kg

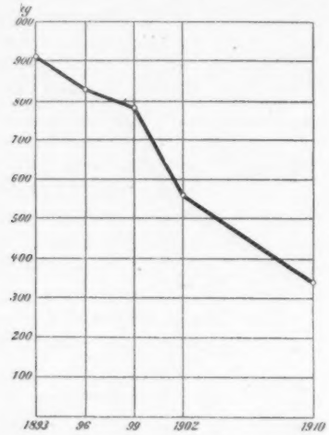



Fig. 4—Diagram Showing Weight of a 10-hp, 1000-r.p.m. D.C. Motor.

(1980 lb.) in 1893 and is only 340 kg (750 lb.) in 1910. The electrical stock companies in Germany paid in the year 1907-8 on the average a dividend of 8 per cent. As to the largest machines built in Germany, there are generators of 12,500 kw, motors of 15,000 hp and transformers of 12,000 kw. The highest e.m.f. produced directly in a generator is 12,000 volts. Reference is made to the use of alloyed steels, to the progress in the construction of turbo-alternators, mercury-vapor rectifiers, high-voltage transformers for testing, etc. Tungsten lamps are now made in candle-powers up to 1000 and down to 0.5. The small 0.5-cp lamps consume 0.15 amp at 3.5 volts. They are used very successfully with portable storage batteries and dry cells. The total rating of motors connected to the German central stations is 1,350,000 hp, while the total rating of all motors in operation in Germany is estimated at 6,500,000 hp. Rapid progress has been made in recent years in the electric equipment of mines and rolling mills. The number of electric stations in Germany is estimated as 50,000 and their rating at 6,500,000 kw, generating per year 7,000,000,000 kw-hours. The number of central stations proper is 2350 in Germany, supplying energy to 6500 cities and towns. The aggregate rating of the central stations is 1,350,000 kw, the number of incandescent lamps connected 15,000,000, that of the arc lamps 300,000, and the rating of cooking and heating apparatus is 50,000 kw. Forty per cent of the energy generated in these stations is used for lighting and 60 per cent for industrial purposes. The paper is to be concluded.—*Elek. Zeit.*, Oct. 6.

*Apparatus for Detecting Fire-Damp in Mines.*—An illustrated description of an apparatus designed to detect the presence of fire-damp or marsh gas in collieries. Fire-damp is a gaseous mixture which contains a considerable amount of hydrogen, and the apparatus takes advantage of the fact that platinum rises in temperature in the presence of this gas. Fig. 5 shows the arrangement. The detector is formed of two strips of metal, shown at the extreme left of the diagram, each rigidly fixed at one end, and the free ends of which overlap. Under normal conditions these remain out of contact with one another. Each strip consists of two pieces of dissimilar metal, such as steel and brass, having different coefficients of expansion, and any heating of these strips causes them to curve. Below the strips are placed coils of thin wire, that on the left being composed of some metal having no catalytic properties and that on the right being made of platinum; these coils are placed in series in a circuit passing to a lamp or resistance in the cut-out box. As long as no hydrogen is present the amounts of heat evolved by the two coils are equal, and the heat is transmitted to the metal strips above the coils, which curve upward equally and do not come into contact with one another; hence, fluctuations in atmospheric temperature or voltage of supply do not upset the arrangement. If, however, fire-damp is present the temperature of the platinum coil increases, and the strip above it curves to a greater extent and makes contact with the overlapping strip. When this occurs current passes through the circuit *S S* to the magnetic solenoid switch *w*, lifting the core of this switch

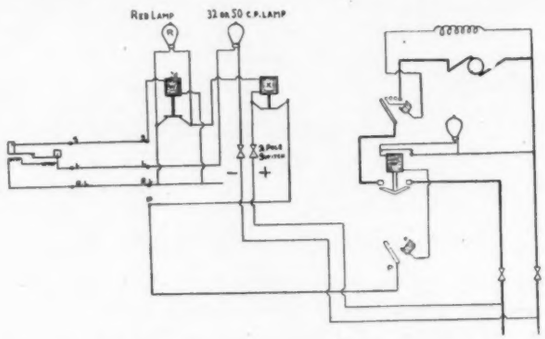



Fig. 5—Connections of Fire-damp Detector.

and breaking circuit on two springs shown. This causes the red lamp *R* to be put in series with the 32-cp or 50-cp lamp shown and the heating coils. The red lamp lights up brilliantly, giving a danger signal, while the current passing through the white lamp and the heating coils is so much reduced that the white lamp goes practically out and the heating coils cool down. By putting this red lamp into series it will be seen also that the current in a second magnetic solenoid switch *x* is also reduced and the core of this second switch falls, breaking connection in a circuit passing to the starting switch of any motor which it is desired to cut off in the presence of fire-damp. In the arrangements shown in the diagram the reduction of current in *x* breaks the circuit of the main solenoid switch controlling the motor, and the switch therefore lies flat in its off position, thus cutting off the supply. If the motor solenoid switch be enclosed in a locked case, an attendant, however foolish, cannot possibly switch current on again under gassy conditions until the solenoid switch *w* has been reset by a person having the key giving him access to the same. The fire-damp cut-out is connected to the supply mains on the supply side of the main double-pole switch controlling the motor circuit which it is desired to protect, so that it is always capable of operation. In this way this protective device is not put out of action at times when the motor switch is off, as, for example, during week-ends; this is important, because the accumulation of gas during such periods is extremely probable, and it is desirable that such an apparatus should prevent the starting of the motor under gassy conditions when work is resumed.—Lond. *Elec. Review*, Oct. 7.

*Meter and Method of Charging.*—A note on a recent British patent (20,815, Sept. 29, 1910) of Siemens Brothers Dynamo Works and F. Lyndall. A description is given of a meter which records at a rate depending upon the irregularity of the demand. It thus retains the essential feature of the maximum-demand system with the advantage of only one instrument and a direct reading. The system consists in charging at a fixed rate per unit multiplied by a variable factor representing the degree of irregularity. The factor is the ratio of the root mean square value of the current over a long period, such as a

quarter-year, to the average current. The speed of the meter is made proportional to the square of the current, and it records the mean square of the amperes flowing over a predetermined period multiplied by the square of the supply voltage and the square of the number of hours in the period divided by 1,000,000.—Lond. *Elec. Eng'ing*, Oct. 6.

*Manchester.*—An abstract of last year's report of the municipal electric station of Manchester. The total number of kw-hours sold by the electricity department during the year was 71,557,387, or over 90 kw-hours per head of population. Of this total about two-fifths is accounted for by electric traction, namely, 28,526,468 kw-hours, while private consumers required 42,886,223 kw-hours, public lighting being responsible for only the small amount of 144,696 kw-hours. The generating cost per kw-hour sold was 0.68 cent, the distribution cost 0.22 cent, the management cost 0.08 cent, the capital cost charges 1.06 cents, rents and taxes 0.24 cent; hence, the total cost, including capital charges, etc., was 2.28 cents. At Manchester the municipality owns both the gas department and the electricity department, and this is causing some trouble, as discussed in the separate editorials. It is pointed out that in many ways it would be better for the Manchester electricity department if the gas supply were in the hands of a private company.—Lond. *Electrician*, Oct. 7.

*Commercial Organization of Central Stations.*—C. KINZBRUNNER.—The author thinks that while for the production and sale of electrical machinery a rather perfect commercial organization has been effected, such organization is still lacking in the distribution of electrical energy. Such a commercial organization, however, is necessary in order to make electricity more popular. Of greatest importance is large-scale soliciting carried out systematically from a central bureau, not in competition with gas, but rather in co-operation with gas companies as far as this is possible. Moreover, electricity should be distributed uniformly over the town, even to the poorer districts. The load factor should be increased by encouraging electric cooking, but the use of electricity for motors and heaters should be limited to certain hours, or at least discouraged for lighting hours. A suitable tariff is of greatest importance.—*Elek. Zeit.*, Sept. 29.

*Excessive Voltages.*—G. GILES AND M. WOHLLEBEN.—The conclusion of their very long reply to the criticism of Schrottke. They maintain their position that condensers and valves are superior to horn lightning arresters and spark-gaps. They claim that during the last five years some 5000 condensers and valves have been installed in practice and four-fifths of this number have replaced horn lightning arresters and spark-gaps, and they are proving successful.—*Elek. Zeit.*, Sept. 29.

*Transformer Protection.*—In providing switchgear for the control of transformers banked in parallel the use of protective devices operating on overloads is accompanied by certain disadvantages. A system of the British Thomson-Houston Company for transformer protection is described which is free from such defects.—Lond. *Elec. Review*, Oct. 7.

### Wires, Wiring and Conduits.

*Plastic Insulating Materials.*—A. HAKANSSON.—The conclusion of his long article on plastic insulating materials. In the present instalment he discusses the ability to withstand high temperatures and gives curves showing the influence of temperature on mechanical strength. He then discusses the methods of forming insulating materials into shape and of machining them and their various applications. Under the name of hard rubber there are a large number of plastic insulating materials in the market which differ very greatly in their properties. For instance, some kinds of hard rubber do not withstand temperatures higher than 70 deg. C., but have a very high insulating resistance and often high mechanical strength and are little hygroscopic. On the other hand, there are kinds of hard rubber that can withstand very high temperatures, but have a comparatively small insulating resistance. In general, it is not proper to judge insulating material from its name.—*Elek. Zeit.*, Sept. 29.

*Thermal and Electric Insulation of Wires.*—A. RUSSELL.—A mathematical paper on the convection of heat from a body cooled by a stream of fluid. In discussing the effect on the convection of heat from a cylinder by putting a covering around it, he shows that if the diameter of the cylinder and the thickness of the covering are sufficiently small the insulating material will have the effect of lowering the temperature of the wire. The following simple experiment illustrates this effect: Portions of a piece of thin manganin wire are insulated with glass, the rest being left bare. When placed in a current of air and heated electrically the bare pieces of wire glow brilliantly, but the portions covered by the glass are quite dark and are therefore at a much lower temperature. In very high-tension systems for the electric transmission of energy the overhead wires are sometimes surrounded with corona, which appreciably increases the transmission losses. The author has previously suggested that the losses would be diminished by insulating the overhead wires with a suitable material of high electric strength. The analysis in the present paper indicates, however, that this procedure instead of diminishing the permissible current in the wires would actually, in many cases, allow an appreciably greater current to be transmitted for the same rise of temperature of the wire.—*Phil. Mag.*, October.

### Electrophysics and Magnetism.

*Ions from Hot Bodies.*—O. W. RICHARDSON AND E. R. HULBIRT.—One of these authors formerly developed a method of measuring the value of $e/m$ for the ions emitted by hot bodies and applied it to the case of the ions of both signs from platinum and carbon. As was to be expected from the results of earlier investigations, the value of the specific charge for the negative ions was found to correspond to that for the negative electrons, whereas the number obtained for the positive ions pointed to bodies of atomic magnitude. Somewhat contrary to expectations, the value of $e/m$ for the positive ions was found to be identical within the limits of experimental error for both platinum and carbon, despite their wide divergence of atomic weight as well as both chemical and physical properties. The values found were also very close to the value given by Sir J. J. Thomson for the corresponding quantity in the case of iron, which appears to have been the only substance for whose positive ions the value of $e/m$ had been determined. The value of $e/m$ in all these cases was about 380 electromagnetic units, and corresponds to an atomic weight of the carriers of about $m/H = 26$, assuming that they carry the same charge as the hydrogen atom in electrolysis. The authors have now extended this investigation to a greater number of metals and alloys, including platinum, palladium, gold, silver, copper, nickel, iron, osmium, tantalum, tungsten, brass, nichrome and steel. In general, the value of $m/H$ differs from a mean value of 25.3 by not more than the error of observation. This mean value is near the atomic weight of sodium, and the authors think it probable that these positive ions which seem common to so many different substances are due to sodium or its compounds which are present as an impurity.—*Phil. Mag.*, October.

*Emission of Ions.*—A. E. GARRETT.—An account of an investigation of the emission of ions from aluminum phosphate on heating. In this case a very large excess of positive ions is given up. The decay of positive ionization was studied. The value found for the ratio of charge to mass indicates that the smallest positive ions present at the lowest pressures must be of a magnitude comparable with that of the hydrogen atom. The high velocity of the ions at low pressures and also the fact that some escape with great velocity even when no external field is applied lead one to expect that a tube in which some aluminum phosphate is heated might be of use as a rectifier for alternating currents. It can be so used.—*Phil. Mag.*, October.

*Photoelectric Fatigue of Metals.*—H. S. ALLEN.—An account of experiments on the diminution of the photoelectric activity of metal surfaces with time. The author concludes that in the case of zinc light is not the primary cause of fatigue, that the

fatigue is practically independent of the electric field, that the fatigue takes place in an atmosphere of hydrogen as in ordinary air, and that the fatigue proceeds more slowly when the plate is kept in a small vessel. To explain the last result one is forced to the conclusion that the fatigue must be due to some substance (ozone, Hallwachs; in the case of zinc, ozone, water, vapor, Ullman) present in small quantities in the atmosphere surrounding the plate. The fatigue must be associated with the condition of the gaseous films on the surface of the plate or with the gas occluded in the metal.—*Phil. Mag.*, October.

*Radiation from Electron Orbits.*—J. H. Jeans.—A mathematical paper in which an attempt is made to examine the nature of the radiation which would be emitted by electrons describing orbits about various centers of force and in fields

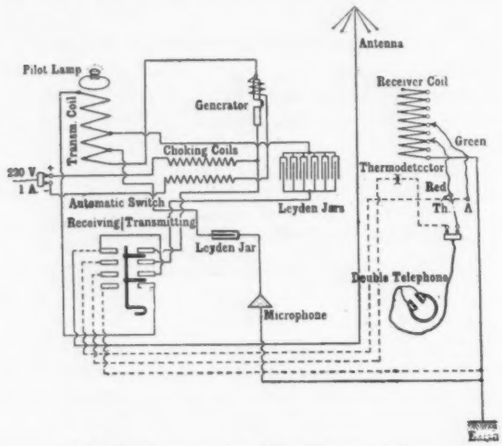



Fig. 6—Circuits for Wireless Telephony.

of force of various kinds, with a view to collecting evidence as to whether black-body radiation can be interpreted as radiation emitted in this way. The author concludes that it is necessary to abandon the hypothesis that the radiation proceeds from electrons describing open orbits. The consideration of closed orbits is reserved for a separate paper.—*Phil. Mag.*, October.

*Radiology.*—Lenard and Ramsauer.—The first report of the Institute of Radiology of the University of Heidelberg. The first part deals with scientific investigations on cathode rays, the photoelectric effect, the conduction of electricity through gases, phosphorescence, luminescence and radio-activity. The second part deals with new apparatus, among them a new cathode-ray tube, a phosphoroscope for measuring and demonstrating purposes, etc. The third part deals with the application of radio-activity for medical purposes.—*Elek. Zeit.*, Oct. 6.

### Telegraphy, Telephony and Signals.

*Wireless Telephony.*—An illustrated description of an experimental and demonstration apparatus for wireless telephony. By its aid it is possible, with a mast of 5 ft., to transmit music as well as the human voice over a distance of about 50 m. The connections for working in both directions are shown in Fig. 6. By closing the plug connection a 220-volt direct-current circuit is completed through a choking coil to the arc generator, in parallel to which is an oscillation circuit consisting of self-induction (transmitter coil) and a capacity (Leyden jars). From the transmitter coil, which is connected at the upper part with the antenna, a branch connection is made through a Leyden jar and a microphone to earth; the coupling between the generator circuit and the antenna is therefore direct. By reversing a switch (automatic) the receiving circuit is put in. It consists of the receiving coil, the thermo-detector (cell) and a double-head telephone. All three instruments are connected in series. Part of the receiving coil is connected to the antenna; the coupling in this case is also direct.—Lond. *Electrician*, Oct. 7.

### Electrochemistry and Batteries.

*Electric Steel Refining.*—G. Arnou.—A review of various electric furnaces proposed or used for steel making and refining, namely, the resistance furnaces of Gin, the induction furnaces and the combination furnace of Roechling-Rodenhauser, and the arc furnaces of Girod, Strassano, Héroult and Keller. An outline is given of what has actually been accomplished in practice, together with a table of different furnaces in operation.—*La Lumière Elec.*, Oct. 1.

# New Apparatus and Appliances

## LUMINOUS AND FLAME ARCS VS. OPEN AND ENCLOSED ARCS.

The paper on "Luminous and Flame Arcs versus Open and Enclosed Arcs" presented by Mr. W. D. A. Ryan at the St. Louis Convention of the National Electric Light Association has been reprinted by the General Electric Company with further illustrations, including some in colors. Charts and curves of the types of lamps treated in the article are shown, and in addition complete instructions in reading them are given. This feature gives it a particular interest to all interested in street illumination. In an introduction to the paper mention is made of the importance of illumination charts and curves and the psychological opposition usually met with in their use by uninitiated persons. The following are the types of lamps studied:

The 9.6-amp carbon open arc, commercially rated at 480 watts, equipped with clear globe and no reflector. The 6.6-amp carbon enclosed arc, commercially rated at 480 watts and equipped with light opal inner, clear outer globes and street reflector. The 4-amp luminous arc, commercially rated at 310 watts and equipped with clear outer globe, internal concentric diffuser and magnetic electrode. The 6.6-amp luminous arc, commercially rated at 510 watts and equipped with clear globe, internal concentric diffuser and magnetite electrode. The 6.6-amp vertical-carbon flame arc, commercially rated at 510 watts and equipped with 26-in. concentric diffuser and light opal outer globe.

A polar curve and a hemispherical chart are shown giving the characteristics of the various types, together with instructions in reading them and conclusions to be drawn.

Fig 1—Boston Flame-Arc Lamp and Ornamental Pole in Copley Square, Boston.

After this study of the characteristics of distribution and the relative spherical and hemispherical efficiencies, attention is

turned to the illumination on the street and two foot-candles in colors and curves are given. A study of the height of lamps above the street is accompanied by two charts partly in color that furnish a ready means of comparing the relative candle-powers and resulting intensities for different spacings and heights of lamps.

While street arcs are employed largely for linear lighting, that is up and down the street, there are many cases where open squares, parks, etc., must be illuminated, and a chart is shown giving a comparison of the area over which the various lamps will project a given minimum light.

The values of the various types of lamps spaced at 500 ft. and 1250 ft. respectively are illustrated in two sector plates in colors. The relative illuminating power of the various units for distances of 250 ft. and beyond, indicating the number of lamps required of each type if massed at one point to equal one Boston flame arc, is given as follows:

| | | | |
|---|---|---|---|
| 6.6 | amp. | Boston flame arc | 1 lamp |
| 6.6 | " | luminous arc | 2 lamps |
| 4 | " | luminous arc | 4 lamps |
| 6.6 | " | enclosed carbon | 5 lamps |
| 9.6 | " | open carbon | 7 lamps |

The Boston type of lamp referred to is the vertical-carbon-flame lamp recently placed on the market by the General Electric Company and is termed Boston type because the first fifty were placed in service in that city to light the principal parks and squares.

Fig. 2—Luminous Arcs on Main Street, Salt Lake City.

The chapter entitled "X Values" treats, in an interesting way, the specifications adopted at the 1907 meeting of the National Electric Light Association. The "X value" is explained as indicating the relative strength of the light as compared with a standard 16-cp incandescent lamp at a fraction of the distance. An arc lamp, for example, having an "X value" of 4 gives the same light as a 16-cp incandescent lamp at one-fourth of the distance, all of the measurements being taken in accordance with definite specifications. In this chapter are given the "X values" of the types of lamps dealt with by Mr. Ryan.

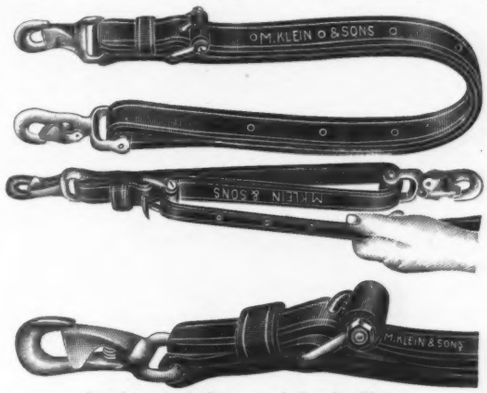
Summarizing, Mr. Ryan says that one of the strongest features of the present conditions of the art of street lighting is that there are now available three high-efficiency units which can be operated in series on the same circuit, as follows:

The 6.6-amp luminous arc for lighting the principal streets; the 6.6-amp Boston flame arc for lighting parks, squares and other places; the 6.6-amp "Mazda" units for residential and incidental lighting.

Photographs are shown of streets in Minneapolis, Detroit, Toledo, St. Louis and Boston, which were made especially for the reprint by the General Electric Company's expert night photographer, Mr. Norris. Two very interesting photographs are those of Park Square, Boston, both taken at the same point, one by daylight, the other at night, the latter illustrating the illumination by the vertical-carbon flame lamps hung there. The accompanying illustrations show a Boston flame-arc lamp and ornamental pole in Copley Square, Boston, and the illumination of Main Street, Salt Lake City, by magnetite luminous arcs.

## COMBINED SAFETY AND SLACK STRAP FOR LINEMEN.

Every lineman is now regularly equipped with a safety belt so as to secure himself in his position when it is necessary to work with both hands on the pole. The ordinary safety belt,




Combined Safety and Lock Strap.

of course, serves this purpose satisfactorily; but inasmuch as it frequently happens that the lineman finds it necessary to use comealongs and to pull up slack wires, the combined safety and slack strap illustrated herewith will doubtless be found convenient and useful. The upper illustration shows the strap as used for a safety strap; the center illustration shows the combination roller buckle and the bottom illustration shows the strap as used in pulling slack. The free snap is of the roller type and the free end of the strap is guided over the roller of the combination buckle, making it a powerful double-purchase pulling device. By throwing the tongue of the buckle into any of the holes along the surface of the strap the load can be held in any desired position. The strap is manufactured by Mathias Klein & Sons, Chicago, Ill.

## LARGE BASE LAMP SOCKET.

The Benjamin Electric Manufacturing Company, of Chicago, Ill., has brought out one-piece, multiple and two-piece, series, large base lamp sockets, together with one having a galvanized flange tapped for ½-in. iron pipe. These are intended for use with lamps having large screw bases, and are adapted for attaching to the surface or bracket by means of screws passing

Fig. 1—One-piece Multiple Set.

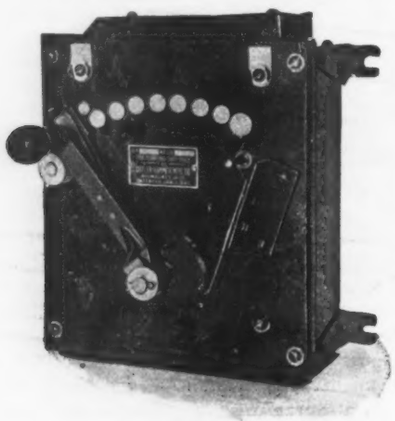
Fig. 2—Two-piece Series Socket.

through the base. The screw holes in the one-piece multiple socket are spaced 1 5/32 in. part, and in the two-piece series socket 1¾ in. apart. The one-piece socket is intended for use on low-voltage circuits not requiring a cut-out or short-circuiting mechanism. It possesses a spring center contact, the wires lead in at the side, and the binding screws are accessible from the central opening. The two-piece, series, cut-out socket has a short-circuiting center contact for high-voltage, street-lighting circuits. It has side connections and will take wires as large as No. 6, and the latter are firmly held by clamping plates.

## STARTERS FOR SINGLE-PHASE MOTORS.

Single-phase motors have done much in helping to build up "day loads," but when starting under load the current often reaches four and five times the normal, thereby causing disturbances to the distributing system. To prevent such occurrences and provide a serviceable apparatus for starting the Cutler-Hammer Manufacturing Company, of Milwaukee, has developed a "primary resistance" starter for single-phase, self-starting motors.

This starter, shown in the accompanying illustration, has been specially designed to meet the requirements of alternating-current motors. The resistance is of the ventilated tubular type so arranged as to eliminate the effect of inductance and provide the highest possible power-factor obtainable in starters of this type. The starter is operated by means of a single sliding lever. A hub-spring attachment prevents an operator from leaving the lever on an intermediate contact, and it is held in the running position by a spring pawl which engages



Single-Phase Motor Starter.

a notch in the fan tail of the lever. The standard apparatus is made for 110-volt and 220-volt circuits, 60-cycles and 133-cycles, in sizes up to 35 hp. As the no-voltage release is not as important a feature as with direct-current starters, it is provided only when desired.

## TUNGSTEN FIXTURES.

With the development of the tungsten filament lamp street lighting as well as indoor lighting is being revolutionized, and central-station men are confronted with the problem of a substitute for the ordinary enclosed arc-lamp systems of lighting installed previous to the development of the tungsten lamp. To meet this demand the George Cutter Company, South Bend, Ind., is placing on the market a "Tungsten Arc," so called because it is designed to give the service of an arc lamp while producing the same beautiful white light as the tungsten filament lamp at an efficiency of from 1 watt to 1¼ watts per candle-power. While not an arc lamp it has been given the above trade name because of its purpose.

The type shown in the accompanying illustration is used to replace the ordinary alternating-current enclosed arc. In doing this it is only necessary to replace the original arc lamp with the lamp shown, the same supporting devices being used. The only change necessary in the wiring is to connect the original leading-in wires to the binding posts of the new lamp. A transformer may be placed in the casing to step the voltage down, or series-tungsten lamps may be used, in which case the arc lamps are fitted with film sockets.

Fig. 2 shows an outrigger type of this same appliance, the fittings of this lamp being made for ¾-in. pipe. The pipe is fastened to a pole or front of a building and the whole fixture is insulated by a high-voltage porcelain joint fastened directly to the casing. A large 22-in. porcelain enameled reflector is used to give a wide distribution of light.

Other types of these arc lamps are made to meet special requirements, as, for instance, lighting factories, stores and store

Fig. 1—"Tungsten Arc" Lamp.

fronts and for street lighting. For outdoor use they have the special advantage of being heavier than most of the tungsten lighting appliances and hence do not tend to swing in the wind so much as the lighter fixtures. Spring-suspended sockets may

Fig. 2—Tungsten Street Lamp, Outrigger Type.

be used to protect the delicate filaments. The chief advantage claimed for the "Tungsten Arc" over other systems of tungsten lighting is that it facilitates concentration of light and thus reduces the number of outlets, and for certain cases meets conditions that no other appliances can.

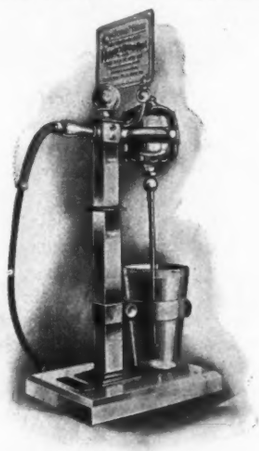
## REMOTE-CONTROLLED DIMMERS FOR CATHEDRAL LIGHTING.

All the subtle effects of finely shaded electric lighting will be used, supplementing the best in architecture and music, to impress those in attendance at the new Cathedral of St. John the Divine, which is building on Morningside Heights, New York City. This structure has been in process of erection for the last twenty-five years and another quarter century will probably elapse before the complete plans of the architects are all carried out, but the basement of the building is already in use for services and the nave will shortly be ready for occupancy. A huge dimmer board, which has already been com-

pleted at the works of the Cutler-Hammer Company, Milwaukee, will be operated by individual motors remotely controlled from contact buttons located in various parts of the cathedral so that the effects can be manipulated from several points as may be desired during the services. The resistance units of the dimmers, unlike those used in theater work, where the effects required are of short duration, have been especially designed for continuous use so that their rated currents can be carried indefinitely.

## ELECTRIC DRINK MIXER.

To supersede the ordinary hand shaker used in mixing drinks at bars and soda-water fountains the Hamilton-Beach Manufacturing Company, of Racine, Wis., is making the electric drink mixer illustrated herewith. An electric motor of 1/12 hp is attached to a standard and operates a vertical shaft, at the bottom of which is the so-called applicator in the form of



Electric Drink Mixer.

a thick button, ¾ in. in diameter, and of a shape particularly designed to set the contents of the glass in motion. The ingredients of the drink are placed in a mixing glass, which is then adjusted in a holder under the vertical shaft. The operator then presses down the machine until the applicator is about 3 in. from the bottom of the glass, when the motor starts automatically. Raising the machine stops the operation of the motor. The motor is said to have a maximum speed of 10,000 r.p.m., and as it is directly connected to the mixer shaft and applicator the contents of the mixing glass are very quickly and thoroughly agitated, the contents of the glass forming in a funnel shape which stirs everything from the bottom toward the top of the glass. The motion mixes air with the drink, making it light and creamy.

A universal motor designed to operate at from 104 volts to 125 volts on either alternating-current or direct-current circuits is used. If alternating current is used the periodicity must be 60 cycles or less. The motor is especially designed, the pole-faces in particular being somewhat different from other small electric motors. It runs on two ¾-in. nickel-babbitt bearings and consumes ½ amp at 110 volts.

Ordinarily two minutes or more are needed to make a mixed drink in a hand shaker and often the result is not entirely satisfactory. With the electric mixer it is said that the mixing may be done in from ten to twenty seconds and that all flavors are perfectly blended in a light, frothy and pleasing beverage. Another advantage is that the machine is sanitary. It is a simple matter to keep it clean, and in this particular it is a decided improvement over the ordinary hand shaker. The novelty of an electric drink mixer, it is pointed out, is also an attraction at drinking bars.

It is said that with a little care the machine will give no trouble in operation. Difficulty may be experienced by endeavoring to force the applicator into the bottom of the glass when it is full of comparatively large pieces of ice. Shaved ice should be used and it is said that a tablespoonful will be sufficient to cool any drink when mixed by the use of this electric device.

## FLAMING-ARC LAMPS FOR ILLUMINATING MACHINE SHOPS.

For some time the Crucible Steel Company of America, at Harrison, N. J., had difficulty in finding a satisfactory means of illuminating its gun and projectile shop. In this shop, which works day and night, turning out guns and projectiles for the United States government, good light is imperative. The guns and projectiles made for the government are built under very rigid specifications, and each shell and gun undergoes very close inspection during the process of construction. It is apparent that without good light much of the work would fail to pass the inspection and thus be rejected.

This shop was formerly lighted by carbon arcs, but these proved unsatisfactory and incandescent lamps were added. These individual incandescent lamps were hung near the various lathes, planers and other machines, and it was thought that this would solve the lighting problem. This combination failed, however, for the men on the night shift were continually having trouble with their eyes. As a last resort flaming arcs were tried and after a thorough test seven Western Electric "Hawthorn" flaming arcs were installed in the main gun shop and three in the adjoining shop. These lamps were run two in series on a 220-volt circuit, and although the voltage is very unsteady, due to the fact that two or three 40-hp or 50-hp induction motors are often started or reversed simultaneously, the lamps are operating very satisfactorily.

After the flaming-arc lamps had been installed for some time it was noted that the increase in the amount of work turned out by the night shift was a little over 10 per cent. In order to determine whether or not this was due wholly to the introduction of the flaming arcs the lamps were taken out for a time and the night work carried on with the old lighting system. It was then found that the amount of work dropped

Flaming-Arc Lamps in a Crucible Steel Gun Shop.

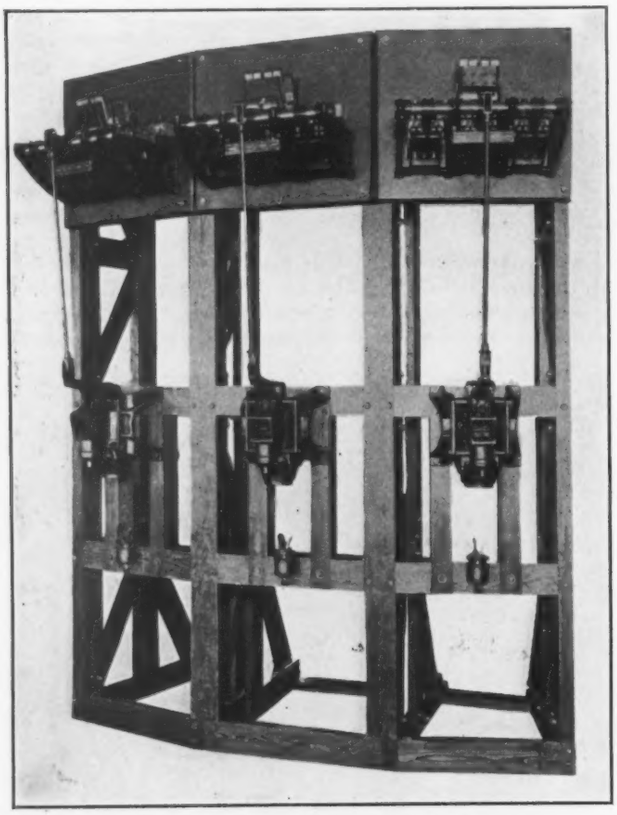
off over 10 per cent and that when the work was again carried on under the flaming-arc lamps the men were able to produce 10 per cent more work.

This increase in production is due not only to the amount of light but to the quality. The golden yellow rays of the flaming-arc lamp are stimulating in character and very easy on the eyes, and since these lamps have been installed night men have found it possible to turn out a greater amount of work with less effort than was possible with the old carbon lamps.

## LARGE ALTERNATING-CURRENT CIRCUIT-BREAKER INSTALLATION.

The General Electric Company has installed the largest alternating-current circuit-breaker yet built in the worsted mills of the American Woolen Company at Lawrence, Mass., its function being to protect a 600-volt, 40-cycle turbo-alternator. It is a triple-pole, solenoid-operated breaker with a current-carrying capacity of 12,000 amp continuously without overheating. If a circuit-breaker for use on heavy alternating-current circuits of 6000 amp and over were built on the lines of usual direct-current construction, it would not perform its work satisfactorily and would heat to a dangerous degree in service. To avoid this special construction must be employed.

In the design of the circuit-breaker in question a large amount of radiating surface was provided and uniform distribution of the current throughout the various parts was ensured by subdividing the contact brushes and the studs of each pole into six sections, each section insulated from the others. Each pole of the circuit-breaker is operated by a separate solenoid mechanism so connected that the entire triple-pole breaker is controlled by a single-control switch on the switchboard panel. The open and closed positions of the breaker are indicated by pilot lamps located at the controlling switch.



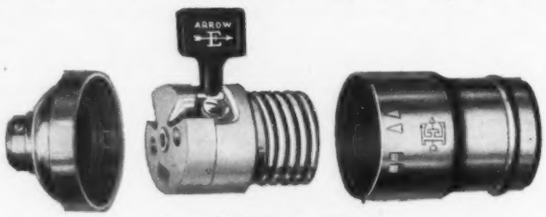
Heavy Alternating-Current Circuit-Breaker.

To obviate the necessity of opening an arc at the control switch the circuit of the closing coils is opened by relays located near the circuit-breaker after the latter closes. The circuit-breaker trip coils are opened by auxiliary switches on it, which open when the breaker itself opens. The device is made automatic by the use of series-transformers and relays. The circuit-breaker, solenoids and control-relays are mounted on specially designed hard-wood supporting framework made to conform to the perimeter of the turbine to which the framework is secured.

Before shipment, after being well tried out for purposes of adjustment and to discover any weak points in construction, the breaker was subjected to thorough mechanical endurance tests under conditions much more severe than it could possibly be expected to endure in actual service. The breaker has now been in service for several months and is operating satisfactorily.

## SNAP-SHELL LAMP SOCKET.

The snap-shell socket illustrated herewith and made by the Arrow Electric Company, of Hartford, Conn., is known as "Arrow Forty." The chief feature of its construction lies in the method by which the shell is attached and detached from the cap. As shown in the engraving, there are four lugs on opposite sides near the upper edge of the shell which engage with notches on the interior of the cap. Twenty notches are




Snap-Shell Lamp Socket.

provided and these are so arranged as to give forty points of adjustment. Two of the lugs on either side of the shell prevent the socket and shell from being pulled apart by straight tension, and the other two lugs straddle the metal strips between slots in the rim of the cap and thus prevent the shell and cap turning relative to each other. In assembling the socket the shell is pushed straight into the cap and given a slight twist to right or left. When the shell is locked in position a distinct click is heard so that no doubt need exist in the mind of the wireman, especially in husk work, that the shell is absolutely fastened. The engaging rim in the cap is made of heavy brass to withstand rough usage.

The manufacturer draws attention to the small, and consequently strong, holding lugs, which do not weaken the shell. The engaging ring contained in the cap also clings tightly to the shell so that the point of strain on the lug is close to the shell at the point of the greatest strength and not on the extreme edge where the leverage is greater and where there is danger of ripping the lug loose from the shell. The positive lock resists a direct pull, an angle pull or a twisting strain; in fact, the design of the socket cap is such that the connection between the outlet nozzle and the cap itself will give before the connection between the cap and the shell will disengage. Nevertheless a slight pressure of the fingers on the shell below the lugs releases it. The interior of the socket is so designed that the weakening of the screw shell by cutting away the base has been reduced to a minimum. A solid screw shell strongly reinforced with heavy brass adds greatly to the life of the socket. The cam operating between the two springs eliminates the grating jar against the solid base, which is so disastrous to the life of tungsten lamps. The contact springs, moreover, cannot be forced out of position or out of contact. The center contact, like the springs, is of phosphor bronze with rounded edges and is not long enough to be twisted under the pressure of the lamp to the side of the shell. Ample room is given in the porcelain for wiring, a feature being the straight run with no corners provided for the wires. In the pull sockets the chain carrier is of heavy fiber and insulates the chain, preventing any possible short-circuit with the binding post. The operating mechanism in the pull socket includes an insulating disk of fiber, which, on breaking the circuit, drops down and smothers the arc, insuring an absolute break and eliminating any tendency to sustained arcing. When necessary the chain horn or chain guide can be easily unsnapped from the customary position without the use of tools and readily replaced. The socket is made in key, keyless, pull and wall types. The shell and cap can be separated by using only one hand, a slight pressure of the thumb being all that is necessary to effect the release.

# Industrial and Commercial News

### The Week in Trade.

THERE was little advancement in the trade situation during the past week. For this condition the weather is being held responsible by the majority of commercial authorities. Summer temperatures which have prevailed over a great part of the country have largely affected retail trade, and have checked liberal purchases. The wholesale and jobbing business of the week displayed that same conservatism which has been observed for many months. The majority of the buying that was done was of the hand-to-mouth character, although in some of the central markets it is claimed that the volume of trade was greater than that for the corresponding week last year. In the South the cotton crop movement has been freer than heretofore, and this has led to a slight improvement in retail buying and also in collections. It is said that the long-delayed specifications by railroads are being prepared, and there are intimations that a good tonnage of steel rails will shortly be ordered. The pig-iron market is not greatly changed, but it is said that the Southern producers are seeking to deal directly with consumers and are cutting out the jobbers and middlemen. The iron and steel manufacturers are practically living upon the hope that the railways will soon come into the market for all kinds of equipment. Business in finished lines shows a slight gain in some centers, but Pittsburgh advices indicate that there is little improvement in that quarter. The demand for structural material is not up to expectations, but the more optimistic manufacturers still declare that a goodly tonnage is pending. The firmer condition of copper has encouraged that industry, and it is said that electrical companies which are known to be fairly busy are buying rather liberally. Collections were distinctly improved during the week, especially in the South and West. Business failures for the week which ended October 20, as quoted by *Bradstreet's*, were 197, as compared with 233 the previous week; 224 in the same week of 1909; 231 in 1908; 220 in 1907, and 184 in 1906.

### The Copper Market.

ADVANCING the asking price of copper to 12⅞ @ 13 cents for electrolytic has, to some extent, stimulated the desire to buy on the part of domestic consumers. This is one of the reasons that the actual transactions in metal were better last week and it has brought a more cheerful frame of mind to the copper market. Almost all of the sales were for November-December delivery, and as a general thing the purchases individually were for small amounts. Consumers with orders ahead are not willing to be caught short of metal while the market is threatening to go higher. Added to this it may also be said that consumers are putting more faith in the promised curtailment of the producers, and also are beginning to believe that the demand for electrical materials will be enlarged after the election. It is said that at the close of the week the demand for electrolytic was slightly easier and that some of the larger selling agencies, notably the United Metals Selling Company, were inclined to shade prices a trifle. In Europe there was some speculative interest in standard warrants, but the net advance in price for the week was insignificant. In Germany and Holland 36,000,000 lb. were placed in warehouses during the week against which certificates were issued which will be traded in on the new German Exchange. Reports from the British Board of Trade for the first nine months of the year show that about 10,000 tons more copper have gone into consumption in England during that period than in the same months of 1909. Imports, while still liberal, are not up to the high records established during the summer. Exports are heavy as a result of the large sales made in July and August. For the month, including Oct. 24, shipments have been 19,670 tons. The daily call on the Metal Exchange, Oct. 24, quoted standard copper as per accompanying table.

| Standard Copper. | Bid. | Asked. | Selling price. |
|---|---|---|---|
| Spot | 12.50 | 12.60 | .... |
| October | 12.50 | 12.60 | 12.55 |
| November | 12.50 | 12.60 | 12.55 |
| December | 12.50 | 12.60 | 12.55 |
| January | 12.50 | 12.00 | 12.55 |

The London market Oct. 24 was as follows:

| | Noon. £ s d | Closing. £ s d |
|---|---|---|
| Standard Copper, spot | 57 5 0 | 57 5 0 |
| Standard copper, futures | 58 5 0 | 58 5 0 |

Extreme fluctuations, for this year:

| | Highest. | Lowest. |
|---|---|---|
| Standard | 13.50c | 11.70c |
| London, spot | £62 0 0 | £52 15 0 |
| London, futures | 65 18 9 | 53 7 6 |
| Best selected | 65 10 0 | 57 15 0 |

### Industrial and Commercial Notes.

**More Edison Storage Battery Cars for New York City.**—The Central Park, North & East River Railroad Company, known as the "Belt Line," which has been operating horse cars in New York City on a number of its lines, has decided to replace this service on West Street with Beach Storage Battery cars, which are equipped with Edison Storage Batteries. The company has practically concluded negotiations for ten of these cars. These cars, if the deal is concluded, will be similar to the No. 1 car now in service on the Twenty-eighth and Twenty-ninth Streets Crosstown Railroad. This car, it is claimed, has proved entirely satisfactory. No application for permission to change the motive power has yet been made to the Public Service Commission. There are at present 100 miles of horse-car lines in the Borough of Manhattan, and it is believed that within a year all of these will be replaced with storage battery cars. The South Shore Traction Company, which runs a line across the Queensboro Bridge, expects to install within a short time a two-truck storage battery car, which is now being completed at the Edison works in Orange. This car will be: Body, 29 ft. long, 7 ft. 6 in. wide; over-all length, 40 ft. 3 in.; two maximum traction trucks, wheels with roller bearings; four 85-volt, 40 amp motors with ball-bearing journals. The seating capacity will be 40 passengers, and the total capacity 100 passengers. It is expected that a single normal battery charge will operate the car 65 miles, and the estimated consumption of energy in kw-hours is 1.3. The total weight will be 16,000 lbs. A certificate was filed last week by the Edison Storage Battery Company showing that it had issued $1,998,200 of additional capital stock. This issue is the outcome of a resolution adopted by the company to increase its capitalization to $3,500,000.

**Interstate Power Company.**—The report recently circulated in South Carolina that the Interstate Power Company, of Anderson, S. C., had purchased control of the Savannah River Power Company is officially denied by representatives of the former company. The Interstate Power Company was organized last winter, and was authorized to issue $5,000,000 of 5 per cent bonds, of which the Carnegie Trust Company of New York was named as trustee. Reference to this organization was made in our issue of Feb. 17, 1910. These bonds have not yet been placed, and the Interstate Power Company has not yet begun the development of the hydroelectric site which it owns at Middleton Shoals, S. C., in the Savannah River. The Savannah River Power Company is operating a plant at Greggs Shoals. This company supplies power to the municipal plants at Greenwood and Abbeville, S. C. The Interstate company expects to develop the Middleton Shoals proposition as soon as the financial market is such that its bonds can be placed at favorable terms.

**New York Electric Lines Company.**—The Supreme Court of New York City denied last week the application made by the New York Electric Lines Company for a writ of mandamus to compel the Empire Subway Company to permit it to lay telephone lines within its ducts. The ground of the decision was that the applying company had not fully established its franchise rights, and that this must be done before a mandamus could be granted. The Electric Lines' Company is a wire-leasing company and is owned by the Great Eastern Telephone Company, which is seeking to operate an independent telephone system in New York City. It is claimed that the independent company has already more than one hundred thousand contracts for service. At the office of the Great Eastern company it was stated that the present decision was not considered conclusive and that the matter would be appealed to higher courts.

**Telephones on the Louisville & Nashville.**—The Louisville & Nashville Railroad Company has just completed the installation of telephone train dispatching and message circuits, supplanting the telegraph on its Knoxville division. These circuits consist of the following equipment: One dispatching circuit from Knoxville, Tenn., to Corbin, Ky., a distance of 105 miles, equipped with nineteen stations; one dispatching circuit from La Follette, Tenn., to Etowah, Tenn., a distance of 114 miles, equipped with sixteen stations, and one message circuit extending from Corbin, Ky., to Etowah, Tenn., a distance of 163 miles, equipped with thirty-six stations. These circuits also connect with the Pine Mountain, Olive Spring and Marysville branches. The lines are equipped with No. 9 B. & S. gage copper metallic circuit. The equipment furnished is a special high-efficiency telephone train dispatching circuit developed by the Western Electric Company. Selectors are employed for calling any station desired without interrupting the service of other stations. The cost of equipping this division amounts to about $36,000. Complete supervision of the work, both of the dispatchers and the men along the line, has been insured by placing telephone equipment at the chief dispatcher's desk and in the superintendent's office, so arranged that by simply taking down a receiver and listening in on the line the dispatcher and the superintendent may at all times be in direct touch and communication with any office on the entire division. The power furnished for operating the selectors and ringing the bells is obtained from motor generator sets. These sets are operated directly from the primary sources of power available, and on alternate days, so that the sets are always in an operative condition. They are arranged so that it is possible to connect all of the offices to either the train wire or message circuit. Test panels are furnished at all stations, making it possible to introduce a portion of the message circuit into the dispatcher's line, in case of trouble on the train wire. The dispatching panels employed in the more complicated stations are of special design, manufactured by the Western Electric Company according to instructions furnished by R. R. Hobbs, who has charge of the telegraph business of the entire Louisville & Nashville Railway system. Work trains and repair trains on this division will be equipped with portable telephone sets, which, used in conjunction with special line poles, make it possible for the employees to get in immediate touch with either the dispatcher or the message operator.

**Western Electric Company Improvements.**—The enlargements of the Hawthorne plant of the Western Electric Company, which were referred to in our issue of Oct. 20, will be in the nature of telephone and cable shops, and will give 300,000 sq. ft. of additional floor space, increasing the Hawthorne plant capacity by 20 per cent. In 1905 it become evident that future expansion in the plants at Polk and Clinton Streets in Chicago would not be sufficient to meet the demands of the company. At that time the company purchased 150 acres of virgin prairie at Hawthorne, and only about 25 acres of this property are now occupied by shops, so it is apparent that there is plenty of room for future growth. Practically all of the manufacturing of the company will be transferred to Hawthorne, including much of that which has up to this time been carried on at the New York City plant. The New York City office will probably always remain the executive and administrative headquarters, but the main manufacturing center will be at Hawthorne. When the company originally came to New York its plant was established there for the purpose of manufacturing supplies for the Western Union Telegraph Company, but that branch of the business is far overshadowed by the development in the telephone industry. The company has already spent about $20,000,000 on its plants that are now in operation.

**Chicago as an Electrical Market.**—In endeavoring to further the industrial activities of Chicago, the trade extension committee of the Chicago Association of Commerce is issuing a number of pamphlets designed to exploit the extent and resources of a number of the leading industries of Chicago. One of these is entitled "Chicago, the Electrical Machinery and Supplies Market." It asserts that "Chicago leads all cities of the United States as a market for electrical machinery and electrical supplies. In quality, quantity and variety the stocks carried here have no parallel." It is declared that the Chicago electrical market is equipped to supply the heaviest demands on the shortest notice, and that selling is done, not from catalog, but almost always from stock. The electrical salesrooms of Chicago are said to form one of the sights of the city, and it is contended that for size, arrangement and equipment they surpass those of any other market. They are got together in a comparatively small area and are easily reached. The buyer who comes in person to the Chicago market for electrical goods will find much to repay him for his visit. Appended to the general introductory statement is a list of fifty-five electrical concerns that are members of the Association of Commerce. Brief lists of the goods supplied by each concern are given.

**Washington Water Power Company.**—Options on about 7000 acres of land on both sides of the Spokane River, in Stevens and Spokane counties, Wash., have recently been acquired by the Washington Water Power Company. This land will be taken over preparatory to an extensive power development which will involve the expenditure of about $1,000,000. With this new property the company will have holdings sufficient to permit it to back up the water for twenty miles. The company has recently purchased the lands and rights of the Big Bend Water Power Company and four power sites owned by H. L. Mordy and associates, of Spokane. On one of these sites at Spalding it is estimated that between 75,000 hp and 80,000 hp can be developed. The plans at this point contemplate the erection of a dam 150 feet high. The Washington Water Power Company is also contemplating, it is said, the erection of a new power plant at Nine Mile Point, on the Spokane River.

**Price of Platinum Continues to Advance.**—The price of crude platinum has continued to advance during the past six weeks until it is now selling at $37 to $38 per ounce. According to the statement of one of the principal importers in the American market, this increase is entirely due to the increased demand from the jewelers, dental manufacturers and electrical manufacturers in this country. Shipments from Russia have been rather slow and the consumption has been unusually large. No new controlling legislation has been adopted by the Russian government which has affected the market, but ever since the selling price went above $25 per ounce—which was about the figure covering the advances of the Russian banks—there has been less disposition to push sales.

**Electrical Construction.**—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at New Orleans, La.; Norfolk, Va.; Lakeland, Fla.; Washington, D. C.; Perrysburg, N. Y.; Columbia, Mo.; Texas City, Tex.; Osyka, Miss.; Dayton, Ohio; Tacony, Pa.; Grand Rapids, Mich.; Logan, Va.; Houston, Tex.; Lyons, N. Y.; Panama; Wilmington, Del.; Klamath Falls, Ore.; Redmond, Ore.; Keewatin, Minn.; Eldora, Ia.; Charleston, S. C.; Detroit, Mich., and Milltown, N. B., Can.

**The Manufacturers' Club.**—The annual meeting of the Manufacturers' Club was held at the Hotel Aspinwall, Lenox, Mass., last week and the following officers were elected for the coming year: President, B. M. Downs, Brookfield Glass Company; vice-president, A. H. Pease, Hard & Hegeman Manufacturing Company; treasurer, Herbert Sinclair, Star Porcelain Company, and secretary, Walter Carey, Westinghouse Lamp Company. The membership of the Manufacturers' Club, the headquarters of which are in New York, is composed of representative electrical manufacturers of the Eastern States.

**Foreign Agency for American Goods.**—A European business firm advises an American consular officer that it desires to represent American manufacturers of incandescent electric lamps with metallic filaments, carbons for arc lamps, insulators, switches and arc lamps. Catalogs, prices, terms, etc., are requested. Correspondence may be in English if desired, and references will be furnished. The name of the firm may be obtained from the Bureau of Manufacturers, Washington, the file number being 5,756.

**Costa Rica Hydroelectric Plants.**—The Aguacate Mine, Inc., an American corporation, is installing a hydroelectric plant on the Rio Grande River and will construct a transmission line from the plant to its mines, a distance of twenty miles. The plant will have a capacity of 5000 hp. The Abangarez Gold Fields, of which Minor C. Keith, of New York, is president, is installing a 3000-hp hydroelectric plant on the Gaucimal River and will construct a transmission line eleven miles long from the plant to its mines.

**Brussels Grand Prize for E. W. Bliss Company.**—The E. W. Bliss Company, Brooklyn, has received a grand prize for its exhibit of machinery at the Brussels Exposition, and also the highest awards for individual machines.

**Sherbrooke (Que.) Power & Railway Company.**—A settlement has been arrived at between J. M. Craig and the Sherbrooke Power & Railway Company over certain water-power rights on the Magog River. The company has purchased from Mr. Craig that portion of his property which it found necessary for its business. The company has now secured a clear title to one of the finest water-powers in the eastern townships district of the Province of Quebec, situated in the center of the City of Sherbrooke. The generating plant is expected to be placed in operation within a few weeks. The control of the Sherbrooke Power & Railway Company was transferred some months ago from ex-Governor P. W. Clement, of Vermont, to a syndicate headed by Clarence J. McCuaig, of Montreal, who is now president of the company. A new franchise was also granted by the municipality in consideration of the company developing the Magog water-power, as well as constructing a large extension of the street railway system.

**Wicomico Electric & Power Company.**—A charter was obtained at the last session of the Maryland Legislature for a new electric railway in Wicomico County, that State, and a company has just been formed in Baltimore, called the Wicomico Electric & Power Company, to construct and operate the line. The company has organized as follows: M. V. Brewington, president; H. James Messick, vice-president; William M. Cooper, treasurer; Mark Cooper, secretary; Jesse D. Price, Levin W. Dorman, W. Jefferson Staton, George C. Bounds, Whitefield S. Lowe and J. B. Culver, directors, all of Baltimore. The Industrial Engineering Company, of Philadelphia, has its representatives, Frank S. Gibson and J. B. Walters, engineers, now looking over the field and contracting for rights of way from Salisbury to Nanticoke Point.

**Chicago Subway Telephones.**—The Illinois Tunnel Company is wiring its automatic telephone system and installing its switchboard equipment, in order to begin partial operation by January. It is said that when the installation of telephones begins from 400 to 500 will be placed daily. There will be 30,000 telephones in service, about 10,000 more than the ordinance requires, by June, 1911. The company has made application to the City Council for permission to open various South Side streets for telephone conduits, and this application has been referred to a committee. It is expected to place fifteen miles of conduit on the south side. Officials of the company say that no further issue of receivers' certificates will be necessary for the telephone installation.

**Isthmian Canal Proposals.**—The general purchasing officer at Washington of the Isthmian Canal in circular No. 611 asks proposals for electrical material, bids for which will be received up to Nov. 14. The schedule includes dynamo brushes, interior conduit and conduit fittings, shades, switches, magneto test sets, lineman's belts and safety straps and tools, trolley wire and fittings, rail bonds, fuses, sockets, globes, insulating tape, arc lamp suspension fittings, copper wire and cables.

**Grand Trunk Secures Traction Line.**—It was announced at Montreal last week that arrangements were being made whereby the Montreal & Southern Counties Electric Railway will pass formally under the control of the Grand Trunk Railway Company. The company is applying to the Dominion Parliament for authority to acquire the electric railway system.

**General Electric Company Equipment.**—George W. Lynch, receiver of the Second Avenue Railroad Company, has made a contract with the General Electric Company for the purchase of 100 double motor equipments, No. 216, to replace old motors on cars now in service.

## *Financial.*

### THE WEEK IN WALL STREET.

IMPROVEMENT continued to be marked in the sentiment of Wall Street during the past week, and actual trading is fully double that of two months ago. During the week prices advanced for practically every active issue. There is also some evidence that the outside public is again becoming interested in the market, and commission houses are feeling more hopeful than they have for months. This improvement of tone is all the more gratifying at the present moment because the financial market has appreciably tightened and the Bank of England during the week advanced its discount rate to 5 per cent. In Wall Street it has been especially noted that those stocks known as the Morgan group were particularly buoyant, and this has led to the general belief that this powerful combination of financiers were full of optimism and looked for substantial advances. Among the specific influences for improvement were the more encouraging reports received from the final crop estimates and the distinctly bettered condition of foreign trade as shown by the September statement. The inquiry for bonds has not been quite as active during the past week as earlier in the month, but is still sufficiently good to be encouraging. The increased interest in stocks quite naturally attracts some attention from bonds. The money market has been little affected by the growth of activity and advance in prices, although rates have somewhat advanced. Quotations Oct. 24 were: Call, 3 @ 3¼; ninety days, 4¾ @ 5 per cent. The quotations in the table are those of the close Oct. 24.

NEW YORK.

| | Oct. 17. | Oct. 24. | Shares sold. | | Oct. 17. | Oct. 24. | Shares sold. |
|---|---|---|---|---|---|---|---|
| All.-Ch. | 11 | 10 | 600 | Int.-Met., pfd | 59 | 59 | 51,960 |
| All. Ch., pfd. | 33½* | 33 | 220 | Mackay Cos.. | 95¾ | 92 | 600 |
| Amal. Cop... | 71⅛ | 69½ | 153,026 | Mackay C.,pf | 78¼* | 75½* | 400 |
| Am. D. T.... | 20½* | 20½* | —— | Man. Elev... | 144 | 143* | 820 |
| Am. Loc..... | 41⅛ | 40½ | 5,300 | Met. St. Ry. | 15* | 15* | —— |
| Am. Loc.,pfd. | 105* | 106* | 130 | N.Y.&N.J.Tel. | 139¼* | 139¼* | —— |
| Am. Tel. & C | 87* | 84* | 132 | Steel, com... | 76⅞ | 78⅛ | 1,188,225 |
| Am. T. & T.. | 139¼ | 138¾ | 10,813 | Steel, pfd... | 120 | 119¼ | 9,770 |
| B. R. T..... | 78⅛ | 77¾ | 62,825 | W. U. T.... | 73½ | 72 | 6,170 |
| Gen. Elec... | 154 | 154¼ | 6,400 | West'h, com. | 72 | 73 | 14,100 |
| Int.-Met. ... | 22⅝ | 23⅛ | 53,000 | West'h, pfd.. | 124* | 124* | 100 |

PHILADELPHIA.

| | Oct. 17. | Oct. 24. | | Oct. 17. | Oct. 24. |
|---|---|---|---|---|---|
| Am. Rys..... | 43* | 43* | Phila. Elec..... | 15¾ | 15¾ |
| Elec. Co. of A.... | 11⅝* | 11⅝* | Phila. R. T..... | 19⅜ | 16⅜ |
| Elec. St. B'ty..... | 51 | 49 | Phila. Trac..... | 82 | 82* |
| E. S. B'ty, pfd..... | 30* | 30* | Union Trac..... | 44 | 39 |

CHICAGO.

| | Oct. 17. | Oct. 24. | | Oct. 17. | Oct. 24. |
|---|---|---|---|---|---|
| Chi. City Ry..... | 180* | 160 | Chi. Tel. Co..... | 120* | 122½ |
| Chi. Rs., Ser. 1..... | 72 | 75* | Met. El. Co..... | 21* | 21* |
| Chi. Rs., Ser. 2.... | 17⅝ | 18⅞ | Met. El., pfd..... | 68 | 65* |
| Com. Edison..... | 116½ | 116 | Nat'l Carbon..... | 127* | 128 |
| Chi. Subways..... | 5½ | 5 | Nat'l Car., pfd..... | 119½* | 119½* |

BOSTON.

| | Oct. 17. | Oct. 24. | | Oct. 17. | Oct. 24. |
|---|---|---|---|---|---|
| Am. T. & T..... | 139½ | 138⅞ | Mex. Tel..... | 5¾* | 5¾ |
| Cum. Tel..... | 143* | 143* | Mex. Tel., pfd..... | 7* | 6 |
| Edison E., Ill..... | 266 | 266 | N. E. Tel..... | 133½* | 135½* |
| Gen. Elec..... | 154¾ | 154⅛ | W. T. & T..... | 19* | 19* |
| Mass. E. Ry..... | 20 | 19¾ | W. T. & T., pfd..... | 90* | 90* |
| Mass. E. Ry., pfd... | 84½ | 84¾ | | | |

*Last price quoted.
Shares sold for week Oct. 17 to Oct. 22.

### FINANCIAL NOTES.

**United Light & Railways Company.**—The United Light & Railways Company has been incorporated under the laws of Maine to take over the properties now controlled by Child, Hulswit & Company, of Grand Rapids, Mich. The new company has an authorized capitalization of $30,000,000, divided into $12,500,000 6 per cent cumulative first preferred, $5,000,000 3 per cent cumulative second preferred, and $12,500,000 common. The company will issue no bonds but assumes $2,231,000 underlying 5 per cent bonds and $500,000 stock of constituent companies. At present there will be issued $2,133,000 first preferred, $866,000 second preferred and $800,000 common stock. The remaining stock will only be issued to take over additional properties. The new company takes over the Fort Dodge (Ia.) Light & Power Company; the Citizens Railway & Light Company, of Muscatine, Ia.; the gas and hot water heating system of Laporte, Ind., and the entire gas business of Fort Dodge, Muscatine and Cedar Rapids, Ia.; Cadillac, Mich.; Mattoon, Ill., and Chattanooga, Tenn. The officers of the company are Frank T. Hulswit, president; Richard Schaddelee, first vice-president; Ralph S. Child, second vice-president; B. C. Robinson, secretary and treasurer, and T. J. Weber, consulting engineer.

**Fort Worth (Tex.) Electric Lighting Properties Sold.**—J. R. Nutt, of Cleveland, Ohio, has bought the properties of the Fort Worth Light & Power Company and the electrical properties of the Fort Worth Gas Company. According to an arrangement with the City Commission, a hydroelectric plant with a capacity of 22,000 hp will be erected on the Trinity River and other large improvements made, calling for a total expenditure of approximately $2,000,000. Besides furnishing power to the Nutt plants, the hydroelectric plant will supply the local electric railway system, the Northern Texas Traction interurban line, and a number of industries in Fort Worth and adjacent territory. Plans for the new work have been prepared by Charles William Ricker. Mr. Nutt is managing director of the Citizens' Savings & Trust Company, of Cleveland.

**General Electric Company Stock.**—There has been a persistent rumor in Wall Street for the last two or three weeks that the General Electric Company was contemplating the issue of a stock bonus of 33 1/3 per cent. This report is denied at the office of the General Electric Company. It is said that there is no occasion for a distribution of stock at the present time. The assets of the company were reduced from a high valuation soon after the organization in 1892. At that time the amount of stock outstanding was decreased, and later, when earnings warranted it, the capitalization was increased, but it is not believed by the management that it would be good policy to further increase the stock at this time. There is every reason to believe that the earnings of the company will continue to be sufficient to pay the present 8 per cent rate dividend, and at the same time to add a comfortable sum each year to the surplus.

**Southern Electric Securities at Auction.**—At the auction of securities in New York last week quite a number of securities were sold which had been held as collateral for the 5 per cent bonds of the Southern Electric Securities Company, of which the trustee was the Knickerbocker Trust Company. These securities included $100,000 of Beaumont (Tex.) Traction Company first mortgage bonds; 6000 shares of Beaumont Traction Company stock; $266,000 of Southern Light & Traction Company of Louisiana first mortgage bonds; $60,000 of Jennings (Pa.) Electric Light & Power Company first mortgage bonds; 300 shares of Jennings Light & Power Company stock; $32,000 of Vicksburg Railway & Light Company first mortgage bonds, and 3750 shares of Vicksburg Railway & Light Company stock. The entire lot was sold for $25,000.

**Augusta-Aiken (Ga.) Railway & Electric Company.**—Redmond & Company and J. G. White & Company, of New York, are at the head of the syndicate which has purchased control of the Augusta-Aiken Railway & Electric Company, of Georgia. The deal includes the purchase of stock and bonds amounting to $4,477,918 par value. Franklin Q. Brown, a member of the banking house of Redmond & Company, has been elected president of the electric company, and will head the new corporation, which will be known as the Augusta & Columbia Electric Railway.

**Chicago Traction Consolidation.**—The new consolidation ordinance permitting the Chicago Railways Company to take over the Yerkes properties in Chicago will run for seventeen years and will, therefore, expire at the same time as the present franchise of the Chicago Railways Company. For about $4,000,000 the Railways company will purchase the property and will secure the use of 128 miles of track, 172 cars and three power houses. The rest of the Consolidated Traction Company property, consisting of 187 miles of track and 344 cars, is outside the city limits and is not included in the consolidation ordinance. The rehabilitation of the property will be pushed forward as rapidly as possible under the direction of the Board of Supervising Engineers of the city and any extension must be constructed that the City Council may direct. Several substations will be constructed at once and additions will be made to the transmission lines and car-barn facilities. This consolidation practically unites all of the surface lines on the north and west sides of Chicago and it is believed points to the ultimate union of all the transit lines in Chicago. In the Chicago stock market the passage of the ordinance has had the effect of creating a large buying interest in traction stocks and Series 1 and 2 of Chicago Railways certificates have rapidly advanced in price.

**Montreal Power-Street Railway Merger Declared Off.**—During the week an announcement was made by President H. S. Holt, of the Montreal Light, Heat & Power Company, that the proposed merger between his company and the Montreal Street Railway Company had been declared off. Mr. Holt stated that the response for proxies had been so half-hearted and the active opposition to the merger so pronounced that he had deemed it advisable to end the negotiations.

**Stolz Electrophone Company.**—The Stolz Electrophone Company, of Chicago, which makes telephonic appliances for the purpose of assisting the partially deaf to hear, has increased its capital stock from $25,000 to $100,000.

### DIVIDENDS.

Cape Breton Electric Company, Ltd., preferred, semi-annual, 3 per cent; common, initial, 1½ per cent, both payable Nov. 1.

Commonwealth Edison Company, quarterly, 1½ per cent, payable Nov. 1.

Houghton County (Mich.) Electric Light Company, semi-annual, preferred, 1½ per cent; common, 1¼ per cent, payable Nov. 1.

Lewiston, Augusta & Waterville Street Railway Company, quarterly, preferred, 1½ per cent, payable Nov. 1.

Montreal Light, Heat & Power Company, quarterly, 1¾ per cent, payable Nov. 15.

Pacific Power & Light Company, preferred, 1¾ per cent, payable Nov. 1.

Sierra Pacific Electric Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

Tampa Electric Company, semi-annual, 4 per cent, payable Nov. 15.

West Penn. Railway Company, Pittsburgh, preferred, quarterly, 1¼ per cent, payable Nov. 1.

### REPORTS OF EARNINGS.

| | Gross Earnings. | Expenses. | Net Earnings. | Charges. | Surplus |
|---|---|---|---|---|---|
| American Light and Traction Company: | | | | | |
| September, 1910 | $335,100 | $9,562 | $325,538 | ..... | ..... |
| September, 1909 | 288,631 | 7,785 | 280,846 | ..... | ..... |
| Aurora, Elgin & Chicago Railroad Company: | | | | | |
| Year ended June 30, 1910 | 1,536,898 | 902,777 | 634,121 | 373,823 | 331,837 |
| Year ended June 30, 1909 | 1,411,723 | 796,270 | 615,453 | 341,325 | 329,619 |
| Coney Island & Brooklyn Railroad Company: | | | | | |
| Year ended June 30, 1910 | 1,470,672 | 1,011,831 | 458,841 | 288,571 | 91,777 |
| Year ended June 30, 1909 | 1,479,173 | 1,007,286 | 471,887 | 308,921 | 175,733 |
| Crosstown Street Railway Company, Buffalo: | | | | | |
| Quarter ended June 30, 1910 | 224,898 | 155,861 | 69,036 | 46,218 | 8,623 |
| Quarter ended June 30, 1909 | 208,445 | 134,141 | 74,304 | 37,175 | 23,211 |
| Fairmont & Clarksburg Traction Company: | | | | | |
| September, 1910 | 62,032 | 18,716 | 43,316 | 13,112 | 30,204 |
| September, 1909 | 47,695 | 15,093 | 32,602 | 12,655 | 19,947 |
| Fifth Avenue Coach Company: | | | | | |
| Year ended June 30, 1910 | 630,325 | 565,226 | 65,098 | 36,715 | 29,109 |
| Year ended June 30, 1909 | 369,406 | 310,986 | 58,416 | 37,248 | 22,036 |
| Kansas City Railway & Light Company: | | | | | |
| September, 1910 | 628,685 | 365,790 | 262,895 | 189,119 | 73,776 |
| September, 1909 | 584,287 | 323,078 | 261,209 | 172,512 | 88,697 |
| Keystone Telephone Company, Philadelphia: | | | | | |
| September, 1910 | 94,340 | 46,594 | 47,746 | 24,762 | 22,984 |
| September, 1909 | 91,908 | 45,070 | 46,838 | 24,682 | 22,156 |
| Kings County Electric Light & Power Company: | | | | | |
| September, 1910 | 352,889 | 181,942 | 170,947 | 109,015 | 61,932 |
| September, 1909 | 286,822 | 155,546 | 131,276 | 91,827 | 39,449 |
| Laclede Gas Light Company: | | | | | |
| Nine months ended Sept. 30, 1910 | 3,274,766 | 1,748,194 | 1,526,571 | 839,004 | 537,365 |
| Nine months ended Sept. 30, 1909 | 2,951,007 | 1,657,057 | 1,293,949 | 844,186 | 364,982 |
| Nashville Railway & Light Company: | | | | | |
| September, 1910 | 163,307 | 89,521 | 73,786 | 33,390 | 40,396 |
| September, 1905 | 155,899 | 84,443 | 71,456 | 33,024 | 38,432 |
| New Jersey & New York Railroad Company: | | | | | |
| Quarter ended June 30, 1910 | 186,481 | 113,874 | 72,607 | 54,940 | 15,838 |
| Quarter ended June 30, 1909 | 169,406 | 105,888 | 63,518 | 40,233 | 18,891 |
| New York State Railways Company: | | | | | |
| Quarter ended June 30, 1910 | 841,558 | 513,439 | 328,118 | 128,790 | 351,228 |
| Quarter ended June 30, 1909 | 766,027 | 487,678 | 278,349 | 107,924 | 204,277 |
| Tri-City Railway & Light Company, Davenport, Iowa: | | | | | |
| September, 1910 | 212,531 | 122,391 | 90,140 | 58,602 | 31,538 |
| September, 1909 | 173,063 | 102,002 | 71,061 | 57,555 | 13,506 |
| United Traction Company, Albany: | | | | | |
| Quarter ended June 30, 1910 | 537,562 | 314,287 | 223,275 | 96,625 | 145,105 |
| Quarter ended June 30, 1909 | 544,013 | 282,852 | 261,161 | 107,177 | 165,220 |

# General News

## Construction News.

KINGMAN, ARIZ.—Preparations are being made by the Frisco Mining & Power Company to operate the machinery at its mines and mills in the Union Pass district by electricity, which will be secured from a transmission line that is to be extended to that section from the main station at Kingman.

PHOENIX, ARIZ.—Plans have been prepared for the Water Users' Association for equipment for an electric power plant to be established at a point near Tempe, which are now in the hands of a board of consulting engineers. A report has been submitted by L. C. Hill, supervising engineer at this point for the reclamation service, under whose direction the plant will be installed, and for which the association has agreed to advance $900,000 within the next two years, at which time the association begins payment of the $8,000,000 invested by the federal government in the Roosevelt and Granite Reef dams. Extensive changes and enlargements of the distributing canal system are contemplated by the association. A new canal is to be built from Scottsdale to a point opposite Tempe, where the electric power plant is to be located.

PRESCOTT, ARIZ.—The contract for erecting a transmission line in Verde Valley for the Arizona Power Company has been awarded to William Nagle and E. Kurmier. The proposed line will extend from the power plant on Fossil Creek to Jerome, a distance of about forty miles, and will cost about $100,000.

TUCSON, ARIZ.—The City Council is considering the question of increasing the water power at the municipal pumping station up the river. It is proposed to raise the dam and develop sufficient power to meet all the requirements of the city. The present plant supplies 2500 hp. The cost of the proposed work is estimated at from $100,000 to $150,000. The city has appropriated $28,000 for service from the Washington Water Power Company.

WINKELMAN, ARIZ.—F. L. Payne and Henry Mitchell, of Phoenix, Ariz., have been granted a twenty-five-year franchise by the Board of Supervisors for construction of a hydro-electric power plant in the Winkelman district. It is proposed to erect a 100-ft. diversion dam and a 12-in. pipe line to convey the water to Winkelman. It is estimated that several hundred horsepower can be developed.

JONESBORO, ARK.—Arrangements are being made by the Home Telephone Company to extend its system from Jonesboro to Marked Tree.

LITTLE ROCK, ARK.—The contract for the construction of the power house in connection with the proposed municipal electric light plant has been awarded to Loftis Collarmore, of Little Rock, for $7,500. The building will be 42 ft. x 100 ft. Contracts for equipment have been awarded. The plant when completed will provide electricity to maintain 1000 arc lamps. The cost of the plant complete is estimated at $55,000. William L. Rogoski is chairman of electrical committee.

HEROULT, CAL.—Plans are being prepared by the Noble Electric Steel Company for the installation of five additional furnaces at its large smelter at Heroult, at a cost of about $300,000. The company is developing several chrome mines near its smelter. Since the demonstration in July of the electric process the furnace has been closed down, owing to the Northern California Power Company being unable to supply electricity during the dry season to operate the plant.

LOS ANGELES, CAL.—Citizens of the East Hollywood, Colegrove and Melrose districts have petitioned the Board of Public Works for street lamps. The light committee has reported that 167 lamps could be installed at a cost of $6,000, but recommends that only $2,000 be expended this fall for installing lamps.

LOS ANGELES, CAL.—Surveys have been completed by the Pacific Electric Railway Company for the extension of its new La Habra line, two and one-half miles east beyond Yorba Linda. The company has also completed a survey for an electric railway to Burbank, extending from the Glendale line at Verdugo wash and following the valley between the foothills and the river.

PORTERVILLE, CAL.—Surveys have been completed by the Porterville Northeastern Railway Company for its proposed electric railway eighteen miles in length, along the north bank of the Tule River, in Porterville. It is understood that contracts will soon be awarded for construction of the road. C. S. Freeland, of Porterville, Cal., is chief engineer.

SAN FRANCISCO. CAL.—United States Commissioner Harry M. Wright has recommended that the temporary injunction granted by the United States Circuit Court prohibiting the Hydro Electric Company from proceeding with the building of a pipe line across the Mono forest reserve be sustained. The matter will be again taken before the United States Circuit Court.

SANTA ROSA, CAL.—The Clear Lake Consolidated Telephone & Telegraph Company, recently organized, has just closed a deal whereby it has purchased the properties, rights and franchises of the Clear Lake Telephone & Telegraph Company, the Northwestern Telephone & Telegraph Company, the Gold Ridge Improvement Company and the telephone plant of the Northwestern Electric Company. A. H. Spur is president of the company, and Fred L. Wright secretary and general manager.

NEW HAVEN, CONN.—Bids will be received at the office of the Board of Education, 87 Orange Street, New Haven, Conn., until Oct. 28 for furnishing electric lamps for the New Haven High School building. Plans and specifications can be obtained at the office of the Board of Education. G. T. Hewlett is secretary of the board.

NEW HAVEN, CONN.—Plans have been prepared by the Shore Line Electric Railway Company for the extension of its railway from Guilford and North Branford, through the Totoket and Foxen regions, across the meadows northeast of New Haven, crossing the Quinnipiac River and connecting with the local system of the Connecticut Company at the corner of State and Ferry Streets.

OAKVILLE, CONN.—At a town meeting held recently the citizens voted to form a fire district for lighting purposes. A committee was chosen to take charge of the matter. B. F. Ball is chairman of the committee.

WASHINGTON, D. C.—Sealed proposals will be received until Nov. 9 for furnishing and installing lighting fixtures in the United States buildings at Athens, Ohio; Davenport, Ia.; Houston, Tex.; Lake Charles, La.; Lancaster, Ohio; New Brunswick, N. J.; New London, Conn.; Salisbury, N. C.; Toledo, Ohio, and Statesville, N. C., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WILMINGTON, DEL.—The Board of Water Commissioners has instructed the chief engineer to look into the cost of installing an electric generating plant to supply electricity for the Water Department. It is proposed to utilize the water power from the Porter Reservoir to the Cool Spring, or to install a steam plant. It now costs about $3,000 per year for lighting the department.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has submitted a proposition to the occupants of the buildings on Market Street to continue the present decorative lighting system on the street until Dec. 31, as a trial, at a very reasonable cost. It is understood that the cost would be from one-half to three-quarters of a cent per foot per night. The present system is not of a permanent character, but can be maintained for a reasonable length of time.

BRONSON, FLA.—The Florida Power Company has filed a $200,000 mortgage in favor of Augustus S. Peabody, of Chicago, Ill., trustee. The company proposes to construct a dam across the Withlacooche River, in the southern part of Levy County, the power to be utilized to generate electricity, which will be distributed in several cities in Levy and adjoining counties, and also for use in the phosphate industry in those sections.

FORT MEADE, FLA.—The City Council has granted S. T. Rivers a franchise to install an electric light and power plant in Fort Meade.

LAKELAND, FLA.—Bids will be received by the Board of Bond Trustees of the City of Lakeland until Nov. 10 for improvements to water and light plant as follows: Three miles of 10, 6 and 4-in. cast-iron pipe, fittings, hydrants, valves and boxes; compound engine, air compressor, generator, exciter and switchboard; constructing pipe lines, setting hydrants, valves and boxes; constructing power house, machinery foundations, reservoir and installing machinery. Specifications may be obtained from H. L. Swatts, secretary. Plans will be on file and can be seen at the office of William W. Lyon, 305 Duval Building, Jacksonville, Fla., consulting engineer.

MIAMI, FLA.—C. T. McCreminon, of Miami, Fla., is reported to be in the market for equipment for an electric light plant for a $16,000 hotel.

PENSACOLA, FLA.—The Board of County Commissioners has awarded the contract for installing freight and passenger elevators in the new county jail building to the Warner Electric Company, to cost about $5,000.

SANFORD, FLA.—It is reported that the city is contemplating the installation of additional machinery in the municipal electric light plant at a cost of $20,000.

ALBANY, GA.—Application has been made to the City Council by C. W. Rawson, of Albany, and associates, for a franchise to construct and operate a street railway system in Albany. It is understood that a company will be formed by local business men to operate the system.

ATLANTA, GA.—Work has commenced on the installation of an oranmental electric illuminating system in Atlanta, Ga. The system is being installed by the Flour City Ornamental Iron Works, of Minneapolis, Minn. Corinthian standards will be used. It is expected to have the new lamps installed by Dec. 15.

BALL GROUND, GA.—A. J. Lovelady, of Ball Ground, Ga., is reported to be in the market for a complete outfit for an electric plant for hotel and store, including a gasoline engine, dynamo and storage battery, of sufficient rating to supply 50 lamps of 16 cp.

FRANKLIN, GA.—It is reported that the North Georgia Electric Company, of Atlanta, Ga., is making surveys of the Chattanooga River just north of Franklin. It is understood that the company is contemplating the construction of a dam and power plant in this vicinity.

MACON, GA.—The transmission lines of the Central Georgia Power Company have been completed from the power plant at Jackson to Macon, and the substation at the power house of the Macon Railway & Light Company in this city is ready to be put in operation. A substation has also been erected at Forsyth, from which electricity will be supplied for the mills and for lighting the city. It is expected to have the plant in operation not later than Nov. 15.

MILLEDGEVILLE, GA.—The plants of the Central of Georgia Guano Company and the Baldwin County Fertilizer Company will be operated entirely by electricity, which will be supplied by the Oconee River Mills electric department.

ROME, GA.—The new plant of the Cherokee Hosiery Mills has been completed, which consists of two-story mill building, 60 ft. x 107 ft., and an engine and dye house, 30 ft. x 80 ft. The plant will be operated by electricity furnished by an electric generator driven by a 125-hp steam engine.

CHICAGO, ILL.—Preparations are being made by the Central Manufacturing District, of Chicago, Ill., for the construction of a new factory building for the J. L. Metz Furniture Company, 60 ft. x 160 ft., six stories high. The building will be equipped with two large electric freight elevators and automatic sprinkler system.

CHICAGO, ILL.—Plans are being prepared by I. & S. Lanski, of Chicago, Ill., for a new factory building, 127 ft. x 165 ft., four stories high, to be erected at the corner of Morgan and Twenty-first Streets. The building will be of reinforced concrete and will be equipped with automatic sprinkler system and freight electric elevators.

KEWANEE, ILL.—The Kewanee Boiler Company is installing four electric cranes, manufactured by the Northern Engineering Works, of Detroit, Mich., in connection with the new additions and improvements to its plant. These cranes are of the alternating-current Northern type E design, ranging from 5 to 55 tons and 55-ft. span.

LOWELL, IND.—The capital stock of the Lowell Telephone Company has been increased from $9,000 to $25,000.

MISHAWAKA, IND.—Plans are being considered by the Fostoria Aluminum Manufacturing Company, of Fostoria, Ohio, for the construction of a concrete foundry building 65 ft. x 95 ft. The proposed foundry will be equipped with oil furnaces for melting brass and aluminum, band saws, molding machines, etc. The entire plant will be equipped for electric-motor drive.

MOORESVILLE, IND.—The Public Service Company, which supplies electricity in Mooresville, is reported to have been placed in the hands of a receiver. It is alleged that the company is insolvent, and that the plant is depreciating and expenses exceed the income. Benjamin R. Mowery is receiver.

MT. CARMEL, IND.—Application has been made to the City Council by the Evansville, Mt. Carmel & Olney Electric Railway Company for a franchise to construct its proposed railway through the main street of Mt. Carmel. The railway will be sixty-five miles in length and will connect Mt. Carmel and Olney and intervening towns. E. Q. Lockyear, of Evansville, Ind., is secretary.

SOUTH BEND, IND.—A new warehouse and office building, 38 ft. x 180 ft., is being erected by the Jacobson-Peterson Company, of South Bend, which will be equipped with electric elevators, bundle chutes and heating plant.

TERRE HAUTE, IND.—The Central Union Telephone Company is making extensive improvements to its local telephone system, which will involve an expenditure of about $100,000, and include a large addition to its main exchange and the installation of new cable and new equipment.

ALLERTON, IA.—It is reported that the local municipal electric light plant, recently completed, was destroyed by fire on Oct. 6, causing a loss of about $8,000.

BRADY, IA.—Preparations are being made for improvements and extension to the local telephone system, which will involve an expenditure of about $12,000. J. J. Paxton and C. A. Fancher are interested in the company.

BURLINGTON, IA.—The Rock Island Southern Railroad Company is securing the right of way for an extension of its railway from Monmouth to Burlington, via Macomb and Oquawka. The company will soon apply for a franchise in Burlington, Ia.

ELDORA, IA.—Preparations are being made by the Park Dam Company, of Eldora, Ia., to begin work on the construction of a cement dam across the Iowa River, at Eldora, and erection of power house and electric system in this city. The company was recently granted a franchise to supply electricity in Eldora. Electrical service is now furnished by the Eldora Electric Light Company, owned and operated by Ferris Brothers. E. H. Lundy, George W. Wood and A. H. Latimer, of Mason City, Ia., are interested in the Park Dam Company.

ELLIOTT, IA.—R. O. Prather, of Griswold, Ia., has applied for a franchise to supply electricity in Elliott.

MARSHALLTOWN, IA.—The proposition to grant a franchise to the Merchants, Mechanics & Farmers' Telephone Company will be submitted to a vote on Nov. 8. If granted a franchise the company proposes to erect an automatic exchange and telephone system in Marshalltown, at a cost of about $100,000.

WEBSTER CITY, IA.—It is reported that the construction of a new power station in Webster City, at a cost of about $50,000, is under consideration.

BONNER SPRINGS, KAN.—The Kansas City, Kaw Valley & Western Railway Company, which proposes to construct an interurban railway from Kansas City to Topeka, via Bonner Springs and Lawrence, is reported to have received authority from the State Railroad Commission to issue $1,500,000 in capital stock and $2,500,000 in bonds, the proceeds to be used for the construction of the railway. The company will take over the Bonner Springs Railway, five miles in length, and the eight miles of road which has been graded. The stock issue is limited to $20,000 per mile and bond issue to $35,000 per mile. J. W. Freeborn, of Kansas City, is president of the company.

McPHERSON, KAN.—The City Council has decided to submit the proposition to issue bonds to the amount of $10,000, the proceeds to be used for extensions and improvements to the municipal electric light plant, to a vote at the November election.

NEWTON, KAN.—It is reported that the Electric Light & Power Company is contemplating doubling the present output of its plant. A condensing outfit will also be installed.

SYLVIA, KAN.—Owing to some irregularity in the proceedings the bond election was not held Oct. 7 to vote on the proposition to purchase the electric light plant owned by B. McKeown. The plant was burned some time ago. The town proposes to purchase the plant and to issue $5,000 in bonds to pay for the rehabilitation of the system. At the present time the town is without electrical service.

WETMORE, KAN.—At an election held recently the citizens voted in favor of the proposition to issue $6,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

NEW ORLEANS, LA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Dec. 3, for two 300-hp boilers, piping, economizer, flue, boiler-feed pumps, motor-generator set, wiring, etc., at the United States naval station at New Orleans. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. The cost of the work is estimated at about $35,000. R. C. Hollyday is chief of bureau.

SHREVEPORT, LA.—The Shreveport Traction Company is contemplating extending its Southern-Fairfield Avenue line in Shreveport, for which it will soon apply for a franchise.

BALTIMORE, MD.—It is reported that plans are being prepared by the Monumental Sugar Refining Company for the construction of a plant near Baltimore which will have an output of 2000 barrels a day. The plant will be equipped for electric motor drive. William L. Frantz, Equitable Building, Baltmore, Md., is financial agent.

BALTIMORE, MD.—V. G. Bloede, president of the Patapsco Electric & Manufacturing Company, has submitted a proposition to Robert J. McCuen, superintendent of the Department of Lamps and Lighting, offering to supply electricity for lighting the municipal building within a reasonable radius of the courthouse and city hall at the rate of 2 cents per kw-hour, providing the company is granted a franchise to extend its transmission lines from the present terminus at the old city limits to the court house and city hall. The city now pays the Consolidated Gas & Electric Light Company 3 cents per kw-hour for the service. The Patapsco Electric & Manufacturing Company's plant is located in Ellicott City, Md., and supplies electrical service in Catonsville, Halethrope, Violetsville and West Baltimore.

UNION BRIDGE, MD.—The Tidewater Portland Cement Company is reported to have contracted with the Wisconsin Engine Company, of Corliss, Wis., for three horizontal cross-compound engines, with cylinders 23 in., 43 in. and 48 in. stroke, to be operated condensing; each to be direct connected to a 925-kva, 3-phase, 60-cycle, alternating-current generator.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has purchased the lot next to its power station, on which it will erect a large addition to its plant. The new building will be equipped with two 300-hp Manning boilers, to replace some of the boilers now in use, and a 750-hp turbine.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has applied to the Massachusetts Gas and Electric Light Commission for permission to issue $300,000 in additional capital stock, the proceeds to be used for taking up the funded debt incurred in making extensions to its plant.

DETROIT, MICH.—Plans are being prepared by Malcomson & Higginbotham, Moffat Building, Detroit, Mich., for the construction of an auto lamp factory, 67 ft. x 200 ft., three stories high. A power plant will also be erected in connection with the plant.

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works until Nov. 3 for two arc generators direct-connected to a motor, with an alternative proposition for six 50-lamp series rectifier systems, complete. Bids will also be received at the same time and place for chain grate stokers for the combination pumping and lighting station for the City of Grand Rapids. Samuel A. Freshney is secretary and general manager of the municipal electric light plant.

MONROE, MICH.—The Raisin River Paper Company is reported to have awarded contracts for the construction of its proposed paper mill to cost about $125,000. The project includes a steam and electric power

plant to cost about $20,000. Machinery and equipment for the works is estimated at about $65,000.

NEGAUNEE, MICH.—It is reported that the Volunteer Ore Company, of Duluth, Minn., is opening up a large mine at Palmer Lake, near Negaunee, for which a large amount of equipment will be required. Compressed air and electricity for operating the machinery will be supplied from the power house of the Volunteer mine for the present. Thomas F. Cole and G. A. Tomilson are interested in the company.

SAGINAW, MICH.—Arrangements are being made by the Jackson & Church Company for the erection of a new plant at Saginaw, Mich., consisting of a pattern shop, foundry, machine shop, finishing shop and several other buildings, including a separate power house. The plant will be equipped for electric motor drive throughout.

CHISHOLM, MINN.—The Mesaba Range Power Company, recently organized with a capital stock of $250,000, will take over the plant and holdings of the Range Power Company, which now supplies electricity in the City of Chisholm. It is understood that the new company proposes to complete the Sturgeon Lake dam project for the development of water power. A. L. Ober, president of the First National Bank, of Chatfield, Minn., is president of the new company, and associated with him are W. W. Boyer, C. L. Thurber, F. G. Stout and M. J. Schermerhorn, of Chatfield, Minn.

KEEWATIN, MINN.—Preparations are being made for the construction of a municipal electric light plant in Keewatin, to cost about $8,000, bids for construction of which have been asked.

ST. PAUL, MINN.—Tentative plans for taking over the power to be developed by the erection of the high dam, near the Soldiers' Home, and its distribution between the Federal government, the University of Minnesota and the Twin Cities are under consideration. The present plan calls for the organization of a company to be composed of the president of the Board of Regents of the university, the dean of the engineering department of the university, the mayors and city engineers of the two cities. This corporation would be authorized by the legislature to raise money for its electric power plant and reserve steam power plant, and to enter into contracts with the two cities and other organizations.

OSYKA, MISS.—Sealed proposals will be received by the Mayor and Board of Aldermen until Nov. 8 for furnishing materials and machinery for an electric light plant and water-works system to cost about $20,000. Plans and specifications can be seen at the office of the Mayor, Osyka, Miss., and at the office of Xavier A. Kramer, engineer, Magnolia, Miss. Clinton Thompson is Mayor.

COLUMBIA, MO.—The City Council is reported to have engaged M. E. Fawkes as engineer in charge of improvements to the municipal electric light plant and water-works system. The work includes the erection of a power station and boiler plant, changing the present arc lighting system to magnetite lamps, and rearrangement of present street-lighting system. A 750-kw electric generating plant will be installed, consisting of a 500-kw high-pressure turbo-generator and a 250-kw generating unit. Bonds to the amount of $125,000 were recently voted for the improvements.

ST. LOUIS, MO.—The Gratiot & Lindenwood Improvement Association is considering the question of building an independent street car line from South Broadway to the suburbs of Greenwood and Maplewood. The South Broadway merchants are expected to co-operate with the association. Charles F. Dollas is chairman of the special committee appointed to take up the matter.

CHINOOK, MONT.—S. W. Swenson is reported to have applied for a franchise to install an electric light plant in Chinook.

AINSWORTH, NEB.—The Ainsworth Electric & Power Company is reported to be contemplating the extension of its transmission line to Long Pine, to supply electricity for lighting the railroad yards and business districts in that town.

FRANKLIN, NEB.—It is reported that preparations are being made to build an electric lighting system in Franklin, bonds for which have been voted.

NORFOLK, NEB.—The City of Norfolk, Neb., has engaged the W. K. Palmer Company, engineers, 717-720 Dwight Building, Kansas City, Mo., to prepare plans and specifications for a municipal electric light plant in Norfolk, and for improvements to the city water-works system.

WEST CONCORD, N. H.—Work has commenced on the improvements to the power house of the street railway company at the South End, which include the erection of a new smokestack and the installation of new boilers.

GARFIELD, N. J.—At an election to be held Nov. 1 the proposition to issue bonds to the amount of $25,000 for the installation of a municipal electric light plant will be submitted to a vote. It is proposed to purchase the distributing system of the Public Service Corporation of New Jersey and install a power plant.

ALAMOGORDO, N. M.—It is reported that the Alamogordo Water Power Company is contemplating the installation of an 800-hp hydro-electric power plant in Box Canyon, near Highrolls. Electricity generated at the plant will be transmitted to the Sacramento Valley to operate irrigating pumping plants and for manufacturing purposes.

BALDWINSVILLE, N. Y.—The Village Board has granted the Syracuse, Lake Shore & Northern Railroad Company, of Syracuse, a franchise to double-track its railway through Syracuse Street, in Baldwinsville.

BALDWINSVILLE, N. Y.—The contract for the construction of the power house for the Seneca River Power Company, at Baldwinsville, N. Y., has been awarded to D. E. Wadsworth, of Fulton, N. Y. Gaggin & Gaggin, of Syracuse, N. Y., are architects.

BROOKLYN, N. Y.—The contract for installing electric equipment in School 167, Borough of Brooklyn, has been awarded to the Commercial Construction Company, 24 State Street, New York, N. Y., for $10 973. C. B. J. Snyder is Superintendent of Schools.

BUFFALO, N. Y.—Sealed proposals will be received at the office of the Department of Public Works, Room 1, City Hall, Buffalo, N. Y., until Nov. 4 for three steam turbine electric generators for the pumping station, foot of Porter Avenue. Plans and specifications can be seen and forms of proposals obtained on application at the Bureau of Water. Francis G. Ward is commissioner.

HUDSON, N. Y.—Contracts for power house equipment for the New York Training School for Girls, at Hudson, N. Y., have been awarded as follows: For electrical work to the New York Construction Company, of New York, N. Y., for $11,524; for steam apparatus to the R. T. Ford Company, of Rochester, N. Y., at $33,775. G. W. Sullivan, of Hudson, is steward.

HUNTINGTON, N. Y.—The Public Service Commission, Second District, has authorized the Huntington Light & Power Company to execute a mortgage for $250,000 and to issue bonds to the amount of $98,000 and additional capital stock to the amount of $2,000, the proceeds to be used for taking up outstanding obligations to the amount of $86,000; for improvements to plants and distributing system, $14,000, and $42,000 to purchase the outstanding bonds of the Huntington Gas Company at a price not to exceed 70.

LYONS, N. Y.—The Safferson & Weisberg Company, which is building a new factory on Geneva Street, has decided to install a power plant to light and operate its works.

NEW YORK, N. Y.—Bids will be received by William H. Edwards, Commissioner of Street Cleaning, until Nov. 1 for furnishing and installing an electric lighting system in several buildings of the Department of Street Cleaning.

NEW YORK, N. Y.—Sealed bids will be received by C. B. J. Snyder, Superintendent of School Buildings, until Oct. 31 for the installation of electric equipment in addition to and alterations to present equipment in Girls' High School, located on Nostrand Avenue, between Halsey and Macon Streets, Borough of Brooklyn, N. Y.

PERRYSBURG, N. Y.—Plans have been prepared for a power plant to be erected at the J. N. Adam Tuberculosis Hospital to be built by the City of Buffalo at Perrysburg, N. Y. The equipment will consist of three 80-hp water tube boilers, feed pump, compression tank pump, vacuum pump, one 50-kw generator and one 20-kw generator, two 5-hp motors and three 1-hp motors. John H. Coxhead, 938 Ellicott Square, Buffalo, is architect. C. A. Hager, of Holland, N. Y., has the general contract for the buildings.

ROCHESTER, N. Y.—The Commercial Register Company, of Buffalo, N. Y., has been consolidated with the Benjamin Account System Company, recently incorporated with a capital stock of $120,000. It is understood that a new manufacturing plant will be erected in Rochester, which will be equipped with modern woodworking machinery. The proposed plant will be operated by electricity furnished by the Niagara Falls plant.

SYRACUSE, N. Y.—The Public Service Commission, Second District, has authorized the Syracuse Light Company to take over from Mortiz Mayer, of Syracuse, N. Y., franchises for an electric transmission line from Solvay to Camillus. The line has been in operation since June 1, and was erected primarily to supply electricity to the Camillus Cutlery Company, with which Mr. Mayer is connected, which also supplies electrical service in the towns of Geddes and Camillus. The cost of the line, including the distributing system, is estimated at about $12,000.

ROSS, N. D.—The Queen City Telephone Company is planning to erect a telephone line to Power Lake in the near future.

DAYTON, OHIO.—Plans are being considered by the directors of the Oakwood Street Railway Company for enlarging its power plant. Changing the location of the plant is also under consideration.

DELAWARE, OHIO.—The contract for electrical work on the new high school building has been awarded to the Electric Supply Company, of Columbus, Ohio.

TOLEDO, OHIO.—The Toledo Railways & Light Company has awarded the contract for construction of its substation to be located at 408 Front Street, East Side, to A. Bentley & Sons, to cost about $15,000. Albion E. Lang is president of the company.

YOUNGSTOWN, OHIO.—The contract for installing a switchboard in the new court house has been awarded to Caldwell & Drake for $4,650. The switchboard will control the lighting system being installed in the building.

CARTER, OKLA.—J. A. Corbell, of Carter, Okla., is reported to be in the market for an electric plant with sufficient output to supply 200 lamps, the equipment to include a gasoline engine, dynamo, switchboard, wire, 16-cp and 32-cp lamps, sockets, wire, etc.

HOBART, OKLA.—Plans are being considered for the installation of electrical apparatus in the municipal pumping station, including a large motor.

PONCA CITY, OKLA.—Preliminary arrangements have been made for the construction of a street railway in Ponca City, for which a franchise will soon be applied for. Frank Hatten and Mr. Steward, both of Ponca City, are interested in the project.

TULSA, OKLA.—Preparations are being made by the Pioneer Telephone & Telegraph Company for installing an underground conduit system in Tulsa for the purpose of placing its wires underground.

KLAMATH FALLS, ORE.—Preparations are being made by the Klamath Light & Water Company to double the output of the Moore plant. An additional water wheel will be installed this fall and another next spring, increasing the output to 10,000 hp. The company proposes to discard the wooden flume to the power house and substitute iron pipe.

PORTLAND, ORE.—It is reported that the Southern Pacific Company is preparing plans for equipping its railway on the west side from Portland to Corvallis, to be operated by electricity.

REDMOND, ORE.—The Crook County Water, Light & Power Company has purchased the plant and holdings of the Cline Falls Water & Power Company, including 1300 acres of agricultural land, irrigation water rights and its rights to Cline Falls water power, including 150 hp already developed. It is understood that the Crook County Water, Light & Power Company proposes to utilize the power already developed and install additional machinery. The company expects to be ready to distribute electricity in Redmond within six months. C. N. Ehret is a director of the company.

SALEM, ORE.—The City Council has granted the Oregon Electric Railway Company, of Portland, Ore., a franchise to lay its tracks on certain streets in Salem.

SPRINGFIELD, ORE.—Plans are being prepared by the Northwestern Corporation for enlarging its local plant. The new equipment will include a 2000-kw turbo-generator set and two additional boilers.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 14 for furnishing electrical material, including fittings, fixtures, insulating material, line material, hardware, tools, rubber gloves, wire, electric and steel cable, etc. Blanks and general information relating to this circular (611) may be obtained from the above office, or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

HARRISBURG, PA.—The contract for furnishing and installing pumping machinery in the high-service pumping station has been awarded to the Birdsboro Foundry & Machine Company, of Birdsboro, Pa., for $15,500. The pumps have a capacity of 100,000 gal. each per twenty-four hours, one driven by a Nash gas engine and the other by an electric motor. Charles A. Hague, of New York, N. Y., is consulting engineer.

LAIRDSVILLE, PA.—The Muncy Creek Telephone Company has increased its capital stock from $5,000 to $15,000. U. G. Boyer is secretary of the company.

QUINCY, PA.—It is reported that plans are being prepared by M. I. Kast, 216 Market Street, Harrisburg, Pa., for an electric light plant for the United Brethren Church Orphanage in Quincy, Pa. It is understood that bids for the construction of the plant will be asked for this fall. The cost of the plant is estimated at $12,000. H. J. Kitzmiller is superintendent.

TACONY, PA.—The Holmes, Tacony & Frankford Electric Railway Company is contemplating the construction of an addition to its boiler house in Tacony, contracts for which will be awarded in the near future. Henry Glazier is general superintendent.

WOODLAWN, PA.—The Woodlawn Light & Power Company, a subsidiary of the Interborough Light, Heat & Power Company of Economy, Pa., has been granted a franchise by the Woodlawn Council to supply electricity in this town. Energy for operating the system will be supplied from the power plant of the Interborough Company, at Economy. A permit has been granted the Interborough Light, Heat & Power Company by the War Department to lay a cable across the Ohio River at Economy, work on which has already commenced. Work on the erection of the plant in Woodlawn will soon begin.

CHARLESTON, S. C.—The special committee appointed by the City Council to make investigations in connection with the installation of a municipal electric light plant and water-works system will soon engage an engineer to prepare plans and estimates for same. The City Council recently made an appropriation of $3,000 to pay for same.

DILLON, S. C.—Plans are being considered for the construction of a municipal electric light plant in Dillon to cost about $15,000. J. M. Carmichael is city clerk.

ROCK HILL, S. C.—An appraisement is being made of the electric plant of the Rock Hill Water & Electric Company to secure a valuation of the property with a view of its being purchased by the city. If the price is satisfactory the plant will be taken over and operated by the municipality; if not, the city will proceed at once to erect a municipal plant.

HURON, S. D.—The question of installing a new street lighting system in Huron is reported to be under consideration.

RAPID CITY, S. D.—The Rapid City Electric & Gas Light Company is contemplating the erection of a new power house and extension of its transmission lines.

CAMDEN, TEX.—The W. T. Carter Lumber Company, it is reported, is contemplating the construction of a timber cutting plant, which will be equipped for electric-motor drive. The plans call for the installation of a large steam-driven power plant.

CHAPIN, TEX.—Preparations are being made by the Valley Reservoir & Canal Company for the installation of a large pumping plant, for which contracts for machinery will soon be placed. The plant when completed will supply water for about 200,000 acres in the lower valley of the Rio Grande River.

ELKHART, TEX.—The City Council is reported to be considering the question of issuing bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system.

FORT WORTH, TEX.—J. R. Nutt, of Cleveland, Ohio, has purchased the plant and holdings of the Fort Worth Light & Power Company and the electrical properties of the Fort Worth Gas Company. He will add to the property a 22,000-hp hydroelectric plant on the Trinity River, and other large improvements involving an expenditure of about $2,000,000. Charles William Ricker has prepared plans for the hydroelectric plant and other improvements.

HOUSTON, TEX.—It is reported that an appropriation of $65,000 has been made for the installation of an electric power plant at the William M. Rice Institute, in Houston. It is understood that contracts for construction of same will soon be awarded.

TEXAS CITY, TEX.—The Texas City Transportation Company is reported to have authorized the installation of an additional 500-kw generator in its power plant. H. B. Moore is general manager.

RUTLAND, VT.—The Penryhn Slate Company has placed a contract with the Rutland Railway & Light Company to equip the Scotch Hill mill and quarry, located about three miles north of Fair Haven, for electrical operation. One 25-hp motor, one 10-hp motor, one 15-hp motor and one 35-hp motor will be installed.

LOGAN, VA.—It is understood that the Arcoma Coal Company will require electrical machinery for mining purposes in the near future, including power plant, chain machine, motors, etc. E. B. Hubard, of Logan, Va., is engineer in charge.

NATIONAL SOLDIERS' HOME, VA.—Sealed proposals will be received at the office of the treasurer of the Southern branch of the National Home for Disabled Volunteer Soldiers, Soldiers' Home, Va., until Nov. 15 for furnishing and installing an electric elevator in the quartermaster's storehouse in accordance with plans and specifications, copies of which with blank proposals can be had on application to John T. Hume, treasurer.

NORFOLK, VA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Dec. 3 for coal and ash-handling apparatus for the central power station at the United States Navy Yard, Norfolk, Va. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. The cost of the work is estimated at $24,000. R. C. Hollyday is chief of bureau.

BELLINGHAM, WASH.—Preliminary arrangements have been made by the Nooksack Valley Traction Company, of Bellingham, Wash., for the construction of its proposed electric railway to connect Bellingham and Sumas. Samuel Alsop is interested in the project.

CENTRALIA, WASH.—The Twin City Light & Traction Company is reported to have succeeded in raising $150,000 for the construction of its proposed power plant. It is said that the company may forfeit its franchise in Centralia and a municipal electric light plant may be established.

ELMA, WASH.—It is reported that the Olympic Railway & Light Company, recently organized by M. H. Lynch and D. E. Servis, proposes to construct and operate an electric power plant to supply electricity for manufacturing plants in Elma and vicinity.

OROVILLE, WASH.—A petition is being circulated by the North Washington Power & Reduction Company asking the city to grant the company a franchise to construct and operate electric transmission lines and telephone lines within the city limits.

SEATTLE, WASH.—The machinery in the new machine shop of the Puget Sound Machinery Depot, being built in Seattle, will be equipped for electrical operation. A large traveling crane will also be installed.

SPOKANE, WASH.—The Spokane Traction Company is reported to be preparing to commence work on the extension of its North Howard and Lincoln Heights lines.

SPOKANE, WASH.—The Board of Public Works has engaged W. E. Moore, hydraulic engineer, as consulting engineer, in connection with the establishment of a municipal electric light plant.

SPOKANE, WASH.—The Washington Water Power Company has recently acquired 7000 acres of land, including power sites, on both sides of the Spokane River, in Spokane and Stevens counties, north of Spokane; it is stated that other land will be purchased preparatory to its extensive power development, which will involve an expenditure of $1,000,000. The company now has holdings sufficient to back water over a strip twenty miles in length. The company recently purchased the lands and right of the Big Bend Water Power Company, located about four miles below the Lapray bridge, and the four sites owned by H. L. Moody and associates above the bridge. On the Spalding site it

is estimated that between 75,000 and 80,000 hp can be developed. The plans call for the erection of a dam 150 ft. in height, connecting perpendicular granite walls 300 ft. from base to cap. The company started work in September on a tunnel in the Spokane River, near its plant in Spokane, but abandoned this work recently. Following the outcome of the litigation respecting the overflow lands just below Cœur d'Alene, Idaho, where the Washington Water Power Company has its chief plant, the management is planning to build a large power plant at Nine Mile Point. D. L. Huntington is president of the company.

WATERVILLE, WASH.—The Home Telephone Company has submitted a proposition to the Farmers' Telephone Company offering to erect a telephone line from Wenatchee to Waterville and connect with the Farmers' Telephone Company's line.

PARKERSBURG, W. VA.—It is reported that the city will soon ask for bids for street lighting on one-year and ten-year contracts. The present contract expires January, 1910.

PARKERSBURG, W. VA.—The Parkersburg, Marietta & Interurban Railway Company is reported to have awarded the contract for a 2000-kw generator in its power plant to provide electricity for the commercial lighting circuit in Parkersburg. C. H. Shattuck is president and general manager.

DELAVAN, WIS.—The Board of Supervisors has granted Hamilton Brown, of Delavan, Wis., a franchise to construct and operate an electric railway in Delavan.

KAUKAUNA, WIS.—The Wisconsin Rate Commission has handed down a decision against the Kaukauna Electric Light Company and has ordered the company to make such improvements and extensions to its plant and distributing system as are necessary to provide an adequate and efficient service within ninety days. The report shows the plant to be wholly inadequate to meet the demands made upon it and that it will practically have to be reconstructed.

MADISON, WIS.—The City Council has granted the Chicago & Wisconsin Valley Railway Company a franchise to build an electric railway in Madison. The proposed railway will connect Madison and Wausau. Allen T. Russell, of Chicago, Ill., is general manager.

SUN PRAIRIE, WIS.—The contract for construction of power station at the municipal electric light plant has been awarded to Lissuer & Hasenfus, of Sun Prairie, Wis.

WYOCENA, WIS.—The Wisconsin State Railroad Commission has authorized the Columbia County Electric Light & Power Company to issue $25,000 in bonds, to be sold for not less than 75, and to issue 280 shares of common stock (par value $25), the proceeds to be used as follows: Bonds to the amount of $18,000 and stock to the amount of $6,950 to be issued and exchanged for the rights and property of what is now known as the Duck Creek Light & Power Company; stocks and bonds to be issued and sold to the amount of $7,000 to provide funds for extensions and improvements to the property.

DUNCAN, B. C., CAN.—The electric light by-law recently submitted to the property owners of North Cowichan municipality was carried by a large majority.

MILLTOWN, N. B., CAN.—Preparations are being made for the installation of a 400-hp electric plant at the St. Croix Mill to furnish electricity for operating the new machinery in the dyeing department and for lighting the mill.

LONDON, ONT., CAN.—The London Electric Light Company is reported to have submitted a proposition to the Mayor and Board of Aldermen, offering to sell its plant to the city at a reasonable price. It is understood that the company will sell out for $200,000.

NIAGARA FALLS, ONT., CAN.—Plans are being considered by the Symmes Construction Company for the construction of a power plant in the Porcupine mining district of Northern Ontario. The proposed plant will be located at Sandy Falls, on the Migogoni River, and from 6000 to 8000 hp will be developed.

WESTON, ONT., CAN.—The Council is reported to be contemplating the construction of a substation to utilize the energy furnished by the Hydro-Electric Power Commission in Weston.

CAPULA, HIDALGO, MEX.—The Mexico Light & Power Company is planning to extend its transmission line from Pachua to Capula to supply the mines and mills of the La Cruz Mining Company with electricity. The mining company will install electrical equipment in order to be ready for the service as soon as the transmission line reaches Capula. It is expected that other mines and industrial plants will also utilize the service furnished by this transmission line.

CULIACAN, SINALOA, MEX.—Surveys and other preliminary arrangements have been completed by the Mayo River Power & Land Company, of Denver, Col., for establishing a large electric power project on the Pacific coast of Mexico. The present plans call for the construction of three large dams and installation of three hydroelectric power plants having a total output of about 300,000 hp. The transmission lines extending from Guaymas on the north and to Tepic on the south, a distance of about 700 miles, will cover the entire Pacific slope territory of Mexico. Transmission lines will be extended into the mining districts and to the towns and cities, involving the erection of about 1200 miles of line. It is understood that tentative contracts have been made by the company with fifteen towns and cities for electrical service. The company has also a contract to supply electricity to operate the trains on a portion of the Southern Pacific Railroad of Mexico. The concessions granted the Mayo River Power & Land Company by the State and Federal governments give it exclusive rights on the Mayo, Humaya and Santiago rivers.

DURAZNO, CHIHUAHUA, MEX.—The Sierra Consolidated Mines Company is reported to have placed contracts for machinery for a steam-driven electric plant. It is understood that other improvements are also contemplated.

GUANAJUATO, MEX.—The La Tula Mining Company has recently installed ten additional motors for operating the machinery of its mills and mines in the Guanajuato district. The mining company now uses about 400 hp, which it obtains from the transmission line of Guanajuato Light & Power Company, of Guanajuato.

HOSTOTIPAQUILLO, JALISCO, MEX.—The Amajac Mines Company, of Hostotipaquillo, has contracted with the Chapala Hydro-Electric & Irrigation Company, of Guadalajara, Mex., for electrical power to the amount of 200 hp, to operate its mill, and also has taken an option on 300 hp additional for future needs. The transmission line of the Chapala Hydro-Electric & Irrigation Company will soon be extended to this district.

MEXICO CITY, MEX.—Announcement has been made that F. T. Snyder, of the Metallurgic Engineering Company, of Chicago, Ill., is contemplating the installation of a plant in Mexico for roasting copper ore with electricity generated by water power.

TORREON, COAHUILA, MEX.—A company has been organized to take over the property and holdings of the Chinese Street Car Company in Torreon. The company is to be capitalized at $200,000 and will take over and operate the system, which was built about two years ago.

## *New Industrial Companies.*

THE BURGLAR ALARM & AUTOMOBILE BELL MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 to manufacture and sell alarms, signals, etc. The incorporators are: W. A. Boeckel, S. Tekulsky, of New York, N. Y., and J. H. Hopkins, of Paterson, N. J.

THE CROSS-MAGILL MOTOR TRUCK COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by C. J. Cross, W. F. Magill, P. S. Tilden, of New York, N. Y. The company proposes to manufacture motors, motor vehicles, etc.

THE ELECTRICAL SHOW COMPANY, of Newark, N. J., has filed articles of incorporation with a capital stock of $60,000. The company proposes to operate exhibits promoting use of electrical appliances. The incorporators are: George Tiernan, Frank H. Parcells and Robert G. Redlefsen, all of Newark, N. J.

THE ELECTRIC SUPPLY COMPANY, of Jackson, Miss., has been organized with a capital stock of $10,000, by John Masal, E. W. Strauss and others.

THE HARRIS AUTO COMPANY, of Atlantic City, N. J., has been incorporated by W. B. Loudenslager, I. B. McDevice, F. C. Muller and A. G. Boettger, of Atlantic City, N. J. The company is capitalized at $60,000, and proposes to manufacture motors, engines, machinery, etc.

THE HYDRO PATENT POWER COMPANY, of Portland, Ore., has been chartered by Norman R. Smith, Frank Becker and C. M. Idleman. The company is capitalized at $1,000,000, and proposes to manufacture and sell machinery for generating power by water. It is understood that the plant is to be erected in Portland, Ore.

THE MACDONALD HYDRAULIC POWER COMPANY, of Paterson, N. J., has been incorporated with a capital stock of $125,000 to deal in hydraulic power systems, plants, machinery, etc. The incorporators are: T. A. Macdonald, of Clifton; I. E. Zimmerman and W. H. Ackerman, of Paterson, N. J.

THE MAGIC DYNAMO COMPANY, of New York, N. Y., has been incorporated by Siegfried Blum and Edouard G. Dupre, 18 East Seventy-fifth Street, New York, N. Y., and Joseph J. Cohn, 139 East Seventy-second Street, New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture dynamos and machinery.

THE MORGAN REGISTER COMPANY, of Anderson, Ind., has been incorporated with a capital stock of $100,000 to manufacture and sell devices for registering fares and for ventilation of cars; also other appliances used in the operation of railways. The company is a successor to the Morgan Fare Register Company. The directors are: Fred A. Morgan, Henry A. Mansfield and H. C. Stillwell.

THE NATIONAL WATER POWER COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $500,000, for the purpose of constructing windmills, waterwheels and motors of every description. The incorporators are: Walter H. Fieroe, John W. Fieroe and Melvina Beyer, of Atlantic City, N. J., and Harry W. Davis, of Wilmington, Del.

THE OTTUMWA-MOLINE ENGINE & PUMP COMPANY, of Moline, Ill., has been incorporated with a capital stock of $100,000 by J. M. Johnston, R. A. Clifton and J. U. Barnard. The company proposes to manufacture machinery.

THE VIRDEN EQUIPMENT COMPANY, of Camden, N. J., has been incorporated by A. W. Ward, of Germantown, Philadelphia, Pa.; W. K. Wood, of Sharon Hill, Pa., and E. L. Dudley, of Camden, N. J. The company is capitalized at $50,000, and proposes to manufacture electrical machinery, appliances, supplies, etc.

THE V. V. FITTINGS COMPANY, of Trenton, N. J., has filed articles of incorporation with a capital stock of $120,000 to manufacture electrical and mechanical specialties. The incorporators are: J. P. Burns, of Philadelphia, Pa.; W. T. Pringle, of Lansdowne, Pa., and W. Gloeckner, of Trenton, N. J.

## New Incorporations.

GLOBE, ARIZ.—The Gila Valley Electric Gas & Water Company has been organized with a capital stock of $100,000. The company proposes to construct a large reservoir and install an electric plant and supply both electricity and water to Layton, Safford and Thatcher. The power plant will be located in Frye Canyon, in the Graham Mountains. The initial installation will provide for 500 hp. A. G. Smith, of Globe, Ariz., is interested in the project.

DOVER, DEL.—The Rector Pittsburgh Lighting & Heating Company has filed articles of incorporation with the Secretary of State, with a capital stock of $125,000. The incorporators are: A. Rector, of New York, N. Y.; J. G. Callanhan, of Otto, Pa., and W. I. N. Lofland, of Dover, Del.

CARNESVILLE, GA.—The Carnesville Railway Company has been granted a charter with a capital stock of $200,000 to construct and operate an electric railway to connect Toccoa, Carnesville, Mize and Red Hill. The incorporators are: W. S. Irwin, J. H. Hicks, E. S. Hunnicull, G. W. Edwards, G. W. Davis, J. C. Andrews, and others.

BOGALUSA, LA.—Articles of incorporation have been filed for the Bogalusa Public Service Corporation with a capital stock of $500,000 by C. W. Goodyear, Jr., N. G. Pearsall, J. K. Breeden and others. The company proposes to construct and operate electric light plants, water works and sewer systems, etc.

HARRISBURG, PA.—Charters have been granted by the State Department to five new companies as follows: The East Bangor Power Company, the Penn Argyle Power Company, the Stockerton Power Company, the Tatamy Power Company and the Wind Gas Company. Each company is capitalized at $5,000, and the directors are the same in all companies: Chesleigh H. Briscoe, 187 Columbia Heights, Brooklyn, N. Y., treasurer; Herbert M. Hagerman, of Bangor, Pa., and Edwin C. Weller, of Portland, Pa.

HARRISBURG, PA.—Charters were issued at the State Department on Oct. 12 to 12 power and illuminating companies to operate in Northampton, Monroe and adjoining counties, the incorporators of all the companies being the same. Each company is capitalized at $5,000, and the titles are as follows: Washington Power Company, of Washington Township; Forks Power Company, of Forks Township; Palmer Power Company, of Palmer Township; all in Northampton County; the Hamilton Power Company, of Hamilton Township, Monroe County, with offices at Bangor, Pa.; East Stroudsburg Power Company, of East Stroudsburg; Lehman Power Company, of Lehman Township, with offices at Bangor; Smithfield Power Company, of Smithfield Township, with offices at Stroudsburg; Middle Smithfield Power Company, of Middle Smithfield Township; Stroud Power Company, of Stroud Township, with offices at Stroudsburg; the Williams Gas & Electric Company, of Williams Township; the Palmer Gas & Electric Company, of Palmer Township and the Forks Gas & Electric Company, of Forks Township, with offices at Easton, Pa.

OTTO, PA.—The Rector Pittsburg Lighting & Heating Company has been granted a charter with a capital stock of $125,000 for the purpose of constructing and operating lighting and heating plants.

PLYMOUTH, PA.—The Forty-Fort Electric Company has been granted a charter with a capital stock of $5,000. The directors are: A. J. Llewellyn, of Plymouth, treasurer; W. C. Anderson, Kingston, Pa., and R. R. Van Horn Ely, of Plymouth, Pa.

## Personal.

*MR. D. McF. MOORE* will read a paper on vacuum-tube lighting before the Baltimore Section of the American Institute of Electrical Engineers on Friday, Oct. 28.

*MR. J. S. PECK,* of the British Westinghouse Company and formerly at East Pittsburgh, has been elected chairman of the Manchester local section of the British Institution of Electrical Engineers.

*M. A. L. SEARLES,* electrical engineer of the Fort Wayne Electric Works, formerly located at Grand Rapids, Mich., is now manager of the rock drill department of that company, with headquarters in Madison, Wis.

*MR. PETER SPANG KLEES,* sales manager of the Franklin Electric Manufacturing Company, was married Oct. 19 at Hartford, Conn., to Miss Daisy Elizabeth Miner, daughter of Mrs. Caroline A. Miner, of that city.

*MR. CHARLES F. UNMACH,* formerly with R. Williamson & Company, of Chicago, is now president of the W. S. Edwards Manufacturing Company, which makes gas and electric light fixtures, with headquarters at 21 Lake Street, Chicago.

*MR. WILLIAM H. WISSING,* vice-president and general manager of the Central Station Development Company, Cleveland, was married in that city on Oct. 19, to Mrs. Mary Frances Lamb. The happy couple will return from their wedding trip about Nov. 1.

*MR. W. S. BOYD,* secretary of the Western Association of Electrical Inspectors, is making an inspection tour to compare Colorado interior wiring conditions and ordinances with those of Eastern territories. Denver, Colorado Springs and Pueblo are the principal points to be examined.

*MR. FRANK J. SPRAGUE* in a letter to the New York *Sun* of Saturday, Oct. 22, criticises the Public Service Commission for not having a representative at the A. I. E. E. meeting on Monday, Oct. 17, to defend the tri-borough plans of the commission, which were the subject of an Institute paper and discussion.

*MR. BELA GATI,* engineer-in-chief and manager of the Royal Hungarian Telegraph & Telephone Experiment Station in Budapest, has arrived in this country for a short visit. Mr. Gáti comes direct from the second Telegraph and Telephone Conference, held in Paris last month, where he presented six papers on telephone subjects. While here he will make a study of long-distance telephony, rapid cable telegraphy and the wireless situation.

*DR. C. P. STEINMETZ,* who spent parts of Oct. 19 and 20 in Chicago, delivered two addresses to electrical men, made some visits of inspection and met a number of the local electrical men socially. On the evening of Oct. 19 Dr. Steinmetz lectured at Fullerton Memorial Hall, Art Institute, before a representative audience of about 300 men on "Industrial Importance of Electrostatics and Electric Impulse Forces." The meeting was the first of the season's joint meetings given by the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers. Mr. J. W. Alvord, president of the Western Society of Engineers, occupied the chair, and Dr. Steinmetz's address, which was of a technical nature, was listened to with closest attention. After the lecture the distinguished visitor and a number of Chicago gentlemen were entertained at the University Club by Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company. Dr. Steinmetz made his headquarters at the University Club while in Chicago. In addition to Mr. Abbott, Mr. J. G. Wray, chief engineer of the Chicago Telephone Company, and Mr. James Lyman, Western district engineer for the General Electric Company, were conspicuous in the local arrangements for Dr. Steinmetz's visit. On the morning of Oct. 20 Dr. Steinmetz, in company with some of his Chicago friends, visited the Ryerson Physical Laboratory of the University of Chicago, where he met Prof. Albert A. Michelson and Prof. R. A. Millikan, of the physics department, and was enabled to see some of the experimental work being carried on at the university, notably the beautiful spectroscopic gratings of Prof. Michelson and the means which he has devised for making them; also the phenomena exhibited by extremely small globules of oil when subjected to the action of an electrostatic field, as opposed to gravity. The latter experiments are being carried out under the direction of Prof. Millikan. At luncheon on Oct. 20 Dr. Steinmetz was the guest of the Electric Club of Chicago, which he addressed on the broad subject of "Electricity." Dr. Steinmetz was received with the utmost enthusiasm by the electrical men present, numbering about 100, and was unanimously elected an honorary member of the club. After a call at the headquarters of the Commonwealth Edison Company, the visitor later in the day departed for his home in Schenectady. His sojourn in Chicago was appreciated by the electrical men of the city and left a pleasant impression.

## Obituary.

*GENERAL T. T. ECKERT,* former president of the Western Union Telegraph Company, died at West End, Long Branch, Oct. 20, after an illness of some duration. Thomas Thompson Eckert was born in Clairsville, Ohio, April 28, 1825. He learned telegraphy at an early age and at the age of twenty-seven in 1852 supervised the construction and became superintendent of a telegraph line from Pittsburgh to Chicago, with which line he remained until it became merged with another company in 1859, when he resigned his position to become superintendent of a gold-mining company in North Carolina. At the outbreak of the civil war he offered his services to the federal government, and was sent to Cincinnati as superintendent of military telegraphs for the Department of the Potomac with the rank of captain. He later became general superintendent of the military telegraph and received the brevet titles of lieutenant-colonel and then colonel. In 1865 he was brevetted brigadier-general of volunteers for meritorious and distinguished service. From July 27, 1866, to February 28, 1867, he was acting Secretary of War. Upon leaving the government service he became general superintendent of the Western Union Telegraph Company, which position he held until 1875, when he became president of the Atlantic & Pacific Telegraph Company until 1881, when he was chosen vice-president and general manager of the Western Union Telegraph Company. In 1893 he was made president of that company, which position he held until his retirement in 1902.

## Trade Publications.

THERMIT RAIL WELDING.—With this title the Goldschmidt Thermit Company, 90 West Street, New York, has issued in handsome form a new edition of its pamphlet describing the various applications of

Thermit to rail welding. Excellent half-tones show the process of welding in practical operation.

HAND-OPERATED STARTING COMPENSATORS FOR ALTERNATING CURRENT MOTORS.—Bulletin No. 4771, entitled "Hand-Operated Starting Compensators for Alternating Current Motors," has recently been issued by the General Electric Company, superseding previous bulletins on this subject.

ENGINE-TYPE DIRECT-CURRENT GENERATORS.—A bulletin has recently been issued by the General Electric Company, entitled "Engine-Type Continuous-Current Generators, Forms RB and RBO for Lighting and Power." The bulletin illustrates and describes direct-current generators for two and three wire systems, from 25 to 250 kw, and for standard voltages.

WESCO SUPPLY CATALOGUE.—The Wesco Supply Company, St. Louis, has issued a catalog, No. 150, which contains about 1400 pages, and covers every department of the electrical industry, including general supplies, electrical novelties and ignition apparatus and supplies, a complete line of street railway material—in fact, everything that pertains to the application of electricity.

PACKARD TRANSFORMERS.—The Packard Electric Company has issued Catalog No. 10, having for a subject transformers for all purposes ranging from 200 kw to 1/10 kw, and including lines for welding work, switchboards and testing. For sign and house lighting with high-efficiency metallic-filament lamps there is a line for secondary voltages from 10 to 55 and with capacities ranging from 1¼ watts to 1/10 watt. A useful addition to the catalogue is a section giving instructions for the testing of transformers.

BENJAMIN LIGHTING SPECIALTIES.—The Benjamin Electric Manufacturing Company, Chicago, has issued, with the title "Benjamin Wireless Clusters and Lighting Specialties," an 80-page pamphlet (B-19) illustrating and describing the many lines of Benjamin electric lighting appliances. The catalog has four divisions, covering respectively wireless clusters and cluster fixtures, special fixtures, lighting specialties, and fixture accessories. A feature of the publication is the inclusion of illumination in the section on special fixtures.

ELECTRIC AUTOMOBILE APPLIANCES.—Bulletin No. 4772, entitled "Electric Automobile Appliances," issued by the General Electric Company, supersedes a previous bulletin on this subject, and will be of interest to all owners or users of electric automobiles for either pleasure or business. The bulletin illustrates and describes an outfit for charging the storage batteries, as well as a combination ammeter and voltmeter for automobiles. It illustrates tungsten lamps for head light, side light and tail light, and also a lamp for limousine illumination. Automobile motors, controllers and air compressor outfits are illustrated and described.

ELECTRIC WIRES AND CABLES.—The American Steel & Wire Company, Chicago and New York, has issued a catalog-handbook presenting in serviceable form information interesting to customers, engineers and students. All types of bare and insulated wires and cables now in common use are fully described. In addition, there is a considerable amount of engineering data and descriptive matter, including an abridged dictionary of electrical terms, which have been introduced for the purpose of making the book a fairly complete treatise on electrical conductors. The book is divided into nine sections. The first contains general data on copper, iron and aluminum conductors; the next seven constitute the catalog portion of the book, and the final section comprises the electrical dictionary. The book, which contains 234 pages, concludes with a very complete index, having conveniently arranged cross references to materials used in electric lighting, telegraph and telephone work.

MAGNETO NON-MULTIPLE SWITCHBOARDS.—Bulletin No. 1020, describing magneto non-multiple switchboards of the sectional unit type, has just been published by the Western Electric Company. It is pointed out that the flexibility of operation and ease of increase in size of these switchboards, which are designed somewhat along the idea of the sectional unit bookcase, make them especially adaptable for small but rapidly growing telephone systems. The bulletin, which is illustrated with many photographs, contains a detailed description of the line circuit apparatus, paying attention both to combined jacks and signals and the line drops. A list of the apparatus required, with different varieties of cord circuits, is given. Other sections are devoted to a description of the operator's telephone circuit and its apparatus, the ringing and night alarm circuit and apparatus, wiring and cabling and line terminal arrangement. The switchboard units are described, as well as methods of assembling these units.

NATIONAL ELECTRIC LAMP ASSOCIATION BULLETINS.—The engineering department of the National Electric Lamp Association has just issued two bulletins, one entitled "Mazda Multiple Lamps" (No. 13), and the other, "Hylo-Economical Turn-Down Electric Lamps" (No. 14). The first mentioned contains twenty pages of practical information and technical data on "Mazda" multiple lamps for use on 100-125 volts and 200-250 volts, three tables and fourteen cuts being included. It is stated that "Mazda" multiple lamps for use on central-station circuits are now available in twenty types, thirteen being designed for 100-125 volts and seven for 200-225 volts, the range in consumption being from 25 watts to 500 watts. Twelve of the twenty types have pear-shaped bulbs, while the remainder have round or meridian bulbs, the former being in seven sizes and the latter in five sizes. Bulletin No. 14 contains twelve pages and describes a new type of turn-down lamp, the principles of which are fully explained and illustrated by means of diagrams. One table and twelve cuts are included in the bulletin.

## BUSINESS NOTES.

THE ELKHART DRY BATTERY & SIGNAL COMPANY, of Elkhart, Ind., has filed a notice with the Secretary of State showing a change in name to the Elkhart Electric-Carno Company.

MESSRS. VAUGHN AND MAYER, consulting electrical engineers, Milwaukee, have been appointed engineers and power-plant experts to the State Board of Control of the State of Wisconsin, which has charge of the various educational, charitable, penal and reform institutions of the State, twelve in number.

THE WESCO SUPPLY COMPANY, ST. LOUIS, is erecting a building on the corner of Eighth Street and Clark Avenue, which will be an exact duplicate of its present building on Seventh Street and Clark Avenue. The company will occupy both structures, which will give practically twice the present floor space, thus allowing increased facilities for quick service, and at the same time a large increase in stock carried.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, of Mansfield, Ohio, announces that the Machinery & Supply Company, of 61 Fremont Street, San Francisco, Cal., has been appointed its Western agent. The Machinery & Supply Company now carries a full line of "Ideal" apparatus, including alternating and direct-current generators, induction motors, both of the slip-ring and squirrel-cage types, special elevator motors and also a complete line of direct-current motors.

JAMES A. GRAHAM has leased the premises at 137 Liberty Street, this city, where he will carry a stock of new and second-hand motors and generators for direct and alternating current for sale or rental, and also electrical instruments, switchboards and other lighting and power accessories. No installation work will be done and no repairs, except to machinery purchased for resale. Mr. Graham has had twenty years' practical experience in the purchase, sale and repairs of electrical machinery.

# Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 18, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

972,799. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; H. A. Balcome, Jamaica Plain, Mass. App. filed March 19, 1902. A brush holder in which the movable member of the clamp is supported and guided by guide rods with lugs to receive the guide rods.

972,811. CIGAR LIGHTER; J. W. Burnett, Cambridge, Mass. App. filed April 13, 1910. An electric resistance is made incandescent to light the cigar and the circuit is broken to save current by a switch, gravity operated, after a predetermined interval.

972,814. ELECTRICAL RELAY; J. F. Cadell, Baltimore, Md. App. filed October 29, 1907. Telephone contact relay with an L-shaped armature and an L-shaped return bar for the magnetism, the latter carrying spring contacts. Details.

972,838. ELECTRIC-WELDING MACHINE; S. Z. De Ferranti, Grindleford Bridge, near Sheffield, England. App. filed Feb. 18, 1907. For attaching turbine blades, including a magazine, with means for transferring a blade from the magazine to holding means, together with means including the holding means for attaching the blade to the carrying element.

972,839. TELEPHONE ATTACHMENT; W. C. Fisk and H. L. White, Orofino, Idaho. App. filed April 14, 1910. For preventing unauthorized listening in by telegraphing the call to the parties conversing by means of a device which is connected to the receiver hook for interrupting the circuit and providing means for preventing the telephone circuit from being opened until the interrupting device is operated.

972,840. FIRE ALARM; J. E. Fogal, A. M. Crichton and A. C. Mowry, Quincy, Ill. App. filed Feb. 18, 1909. An electric signal system with a circuit controller normally closed and biased open and then to close the circuit with a signal released by opening the circuit and causing signals on reclosing the circuit.

972,850. ROTARY FIELD MEMBER OF DYNAMO ELECTRIC MACHINES; A. M. Gray, Milwaukee, Wis. App. filed May 13, 1909. For ventilating and cooling by means of fans on the frame with field magnets having radial ventilating passages and field coils spaced from the poles so as to form air spaces communicating therewith.

972,874. SELF-ACTING TELEPHONIC LINE CONNECTING SYSTEM; B. Kugelmann, Bad Kissengen, Germany. App. filed June 12, 1907. The subscribers' lines are divided into groups and a number of selectors are provided for each group, each having a traveling contact moved into two directions, in one direction making contact with the common line and each selector contacting with the subscribers' line.

972,892. RECTIFIER; W. Meyer, Chicago, Ill. App. filed March 30, 1908. Alternating current rectifier, including a balanced chemical rectifier and an alternating circuit in which the fluctuations are nullified with an aluminum cell, acting as a condenser bridged across the direct-current leads of the chemical rectifier.

972,929. DYNAMO ELECTRIC MACHINE; C. E. Search, Milwaukee, Wis. App. filed March 27, 1909. A turbo generator with an enclosing housing, including a yoke having an annular portion supporting the end cover and clamping devices holding the end cover against the yoke, so that it may be turned relatively to the yoke to any angle.

972,947. ELECTROLYTIC DECOMPOSITION OF SOLUTIONS; C. P. Townsend, Washington, D. C. App. filed April 12, 1902. Passes an electric current through the solution and a diaphragm to an electrode and recovers a product by means of a non-saponifying oil.

972,950. COIL; A. Voegtle, H. C. Lea and R. H. Voegtle, Sharpsburg, Pa. App. filed June 17, 1909. Inductive resistance arc coil, consisting of a magnetic core with sectional coils wound around the limbs of the core. Details.

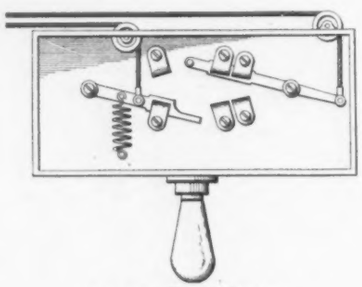
972,956. TERMINAL PLUG RECEPTACLE; J. E. Ward, New York, N. Y. App. filed July 9, 1909. For charging storage batteries on railway cars in yards by means of a yard plug, including a casing pivoted to a bracket, so as to swing parallel with the car-bearing surface of the bracket a block having one or more electrodes supported within the casing.

972,962. SERVICE METER SYSTEM; A. H. Weiss, Chicago, Ill. App. filed Nov. 29, 1907. Central-energy, three-conductor telephone system with service meters at the central office to register calls made by a subscriber. Includes a cut-off relay, a service meter, an auxiliary resistance normally in series with the relay, but shunted by actuating the service meter, a cord circuit and voltages to actuate the meter or to connect it with the line.

972,963. ELECTRICAL FUSE; A. West, Westminster, London, Eng. App. filed Dec. 4, 1909. A fuse carrier with insulating side lugs in one piece, with a contact sheet between and a spring pressing the sheet outward.

972,964. THERMIC CIRCUIT CLOSER FOR ELECTRO-MAGNETIC APPARATUS; G. White, Chapel Hill, Tenn. App. filed Sept. 2, 1909. An opened top gas tube containing mercury having a line which absorbs moisture, in which the terminals are located.

972,986. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed March 27, 1907. A pair of plates conduct current to the terminals of the lamp-receiving socket, the plates being secured to bases and holding the sockets in the casing.



973,154.—Signal System.

972,987. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 11, 1907. An insulating block with an inner casing, a center contact for each lamp holder and also an outer contact for each, the outer contact being carried on the casing with a conductor on the block with which the outer contacts engage.

972,988. INDICATING MEANS FOR PARTY LINE TELEPHONES; J. H. Blythe, Denver, Colo. App. filed June 24, 1907. An indicating member with a disk having a recess on the periphery of its inner face for actuating the indicator, the disk being actuated through electro-magnetic means to show the condition on the line.

972,994. INSULATOR; J. H. Campbell, Ripley, O. App. filed Nov. 23, 1904. For stringing telegraph and telephone wires, the insulator having a head to which the wire is secured and a pin for attaching it to a support with a groove in the head and a bead cross-arm extending into the groove, over which bead the head fits.

972,999. ELECTRIC REVERSING SWITCH; J. F. Cavanaugh, Providence, R. I. App. filed Nov. 5, 1908. Reversing switch for spark coil to change the direction of current to the contact point each time the connection is made by means of a switch, a pivoted arm swinging between the contacts with means for shifting them on the arm to reverse the current passing through the contacts.

973,000 RESISTANCE GRID; H. W. Cheney, Milwaukee, Wis. App. filed Dec. 26, 1908. A zig-zag resistance spring with free end turns and a single bar, which braces the end turns.

973,030. AUTOMATIC GAS IGNITER AND SAFETY DEVICE; E. E. Gerald, Baltimore, Md. App. filed Jan. 22, 1910. Burner, gas supply pipe, valve and buttons on the stem of the valve, the valve closing an electric circuit with a resistance above the burner in the path of the escaping gas, and a rod which when heated by the flame controls the valve so as to automatically relight the gas when extinguished by the wind.

973,037. ROTOR FOR HIGH-FREQUENCY, ALTERNATING-CURRENT MACHINES; A. E. Guy, Trenton, N. J. App. filed April 10, 1909. A disk with teeth of magnetic material, certain of which bridge the spaces between the teeth and filling pieces between the teeth.

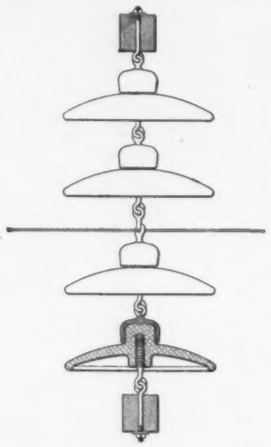
973,089. ELECTRIC HEATER; H. C. Walter, Wilkinsburg, Pa. App. filed Oct. 11, 1909. For the window of an electric railway car to keep the window pane from sleeting, consisting of a sheet of mica and a resistance coil, which can be attached to the window.

973,096. PLUG SWITCH; F. B. Adam, St. Louis, Mo. App. filed Dec. 20, 1909. Single-pole plug switch, including movable arms having at their outer ends semi-circular portions forming a cylindrical sleeve for receiving the cylindrical contacts.

973,152. ELECTRICAL MEASURING INSTRUMENT; M. J. Wohl, New York, and H. Hertzberg, Brooklyn, N. Y. App. filed Nov. 26, 1907. Includes a metallic wire or ribbon, which, when heated, moves a pointer and provides an automatic slack take-up, including a torsion spring for the ribbon.

973,154. SIGNAL SYSTEM; R. S. Woods, Los Angeles, Cal. App. filed July 19, 1909. For controlling a train of two or more cars in giving the starting signal to the motorman and the stop signal by means of switches on the car roof controlled by cords pulled by a conductor, the switches being in series and a bell and battery arranged to be thrown in series therewith or shunted around the same.

973,171. PROCESS OF TREATING BARIUM CHLORID AND STRONTIUM CHLORID FOR PRODUCING CHLORIN AND HYDROXID OF THE SAID METALS; A. Clemm, Mannheim, Germany. App. filed March 11, 1910. Subjects a solution of a chlorid of an alkaline earth to electrolysis until the chlorid solution is nearly saturated with the hydroxide.



973,204.—High-Potential Insulator.

973,198. TELEPHONE RECEIVER HOLDER; J. F. Hines, Pittsburg, Pa. App. filed Nov. 18, 1909. For desk telephones in which a pair of clamps connected to the pedestal carry the support for the telephone receiver when removed from the hook.

973,199. CLUSTER SOCKET; D. Holden, Upper Montclair, New Jersey. App. filed March 16, 1908. A rigid metallic ring to which is bolted a plurality of insulators and threaded shells, the bolts forming center contacts.

973,204. INSULATING SYSTEM FOR HIGH-POTENTIAL ELECTRIC CONDUCTORS; F. M. Locke, Victor, N. Y. App. filed Aug. 27, 1908. A series of insulators in sequence and separated and supported at opposite sides. The insulators may turn with respect to the supports.

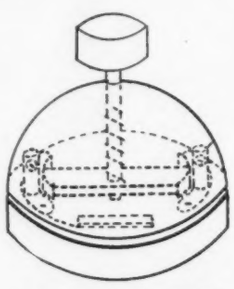
973,216. ELECTROMECHANICAL DEVICE; G. H. Rowe, Berwyn, Ill. App. filed Oct. 17, 1908. A riveter, having a plunger partly magnetic and partly non-magnetic, the latter forming the striking portion, with a field coil surrounding the plunger and a motor within the casing for reciprocating the field core.

973,250. ELECTRIC FUSE; I. E. Barricklow, Antioch, Cal. App. filed Feb. 10, 1910. A retainer for the fuse cover which slides on the casing and covers the joint between the cover and the casing.

973,257. INDICATING-SWITCH; R. C. Browne, Salem, Mass. App. filed Nov. 19, 1906. An indicating rotary snap switch, having a bell-shaped cover and hammer for ringing the bell.

973,322. THROW-OUT SWITCH; W. H. Tucker and W. F. Waddell, New York, N. Y. App. filed March 10, 1909. For cold storage in which fans circulate the air, the fan being stopped in the present instance when a fire breaks out, by means of a cut-out switch and latch, the latch being controlled by a fuse and gravity device.

973,336. METHOD OF PRODUCING METAL SALTS AND METALS; J. Woods Beckman, Niagara Falls, Ont., Canada. App. filed May 7, 1910. Electrolizes a calcium salt of a metal in a fused condition as by heating an oxide of the metal with calcium oxide in an electric furnace and then electrolizing the bath in a state of fusion.



973,257.—Indicating Switch.

973,340. RINGING MACHINE; J. E. Burge, Lincoln, Neb. App. filed Dec. 6, 1907. Rotary pole changer, including a motor and circuit-maker and breaker upon the armature shaft, bell circuit and brushes controlled by the circuit-maker.

973,362. ELECTRIC SWITCH; E. K. Mackintosh and E. A. Smith, Washington, D. C. App. filed Dec. 16, 1909. For indicating the level of water by means of a shaft and wheel controlled by a float and controlling contacts.

973,409. INSULATED HANGER; E. Crabbe, Seattle, Wash. App. filed Feb. 19, 1910. A block with a groove for the wire, the groove spanned by a yoke which is hooked to a screw eye.